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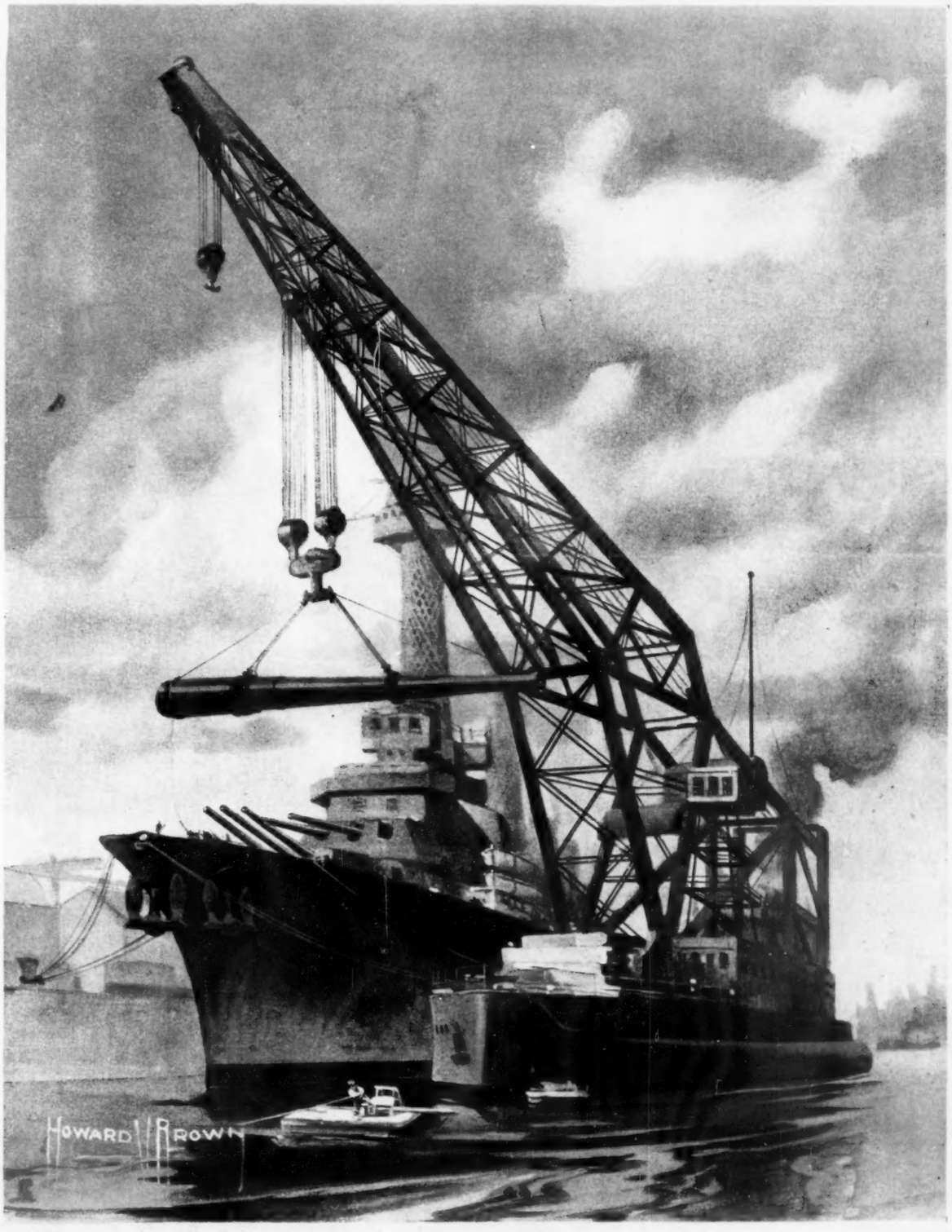
SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



THE "KEARSARGE"—ONCE A BATTLESHIP, NOW A FLOATING CRANE.—[See page 249]

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March 26, 1921

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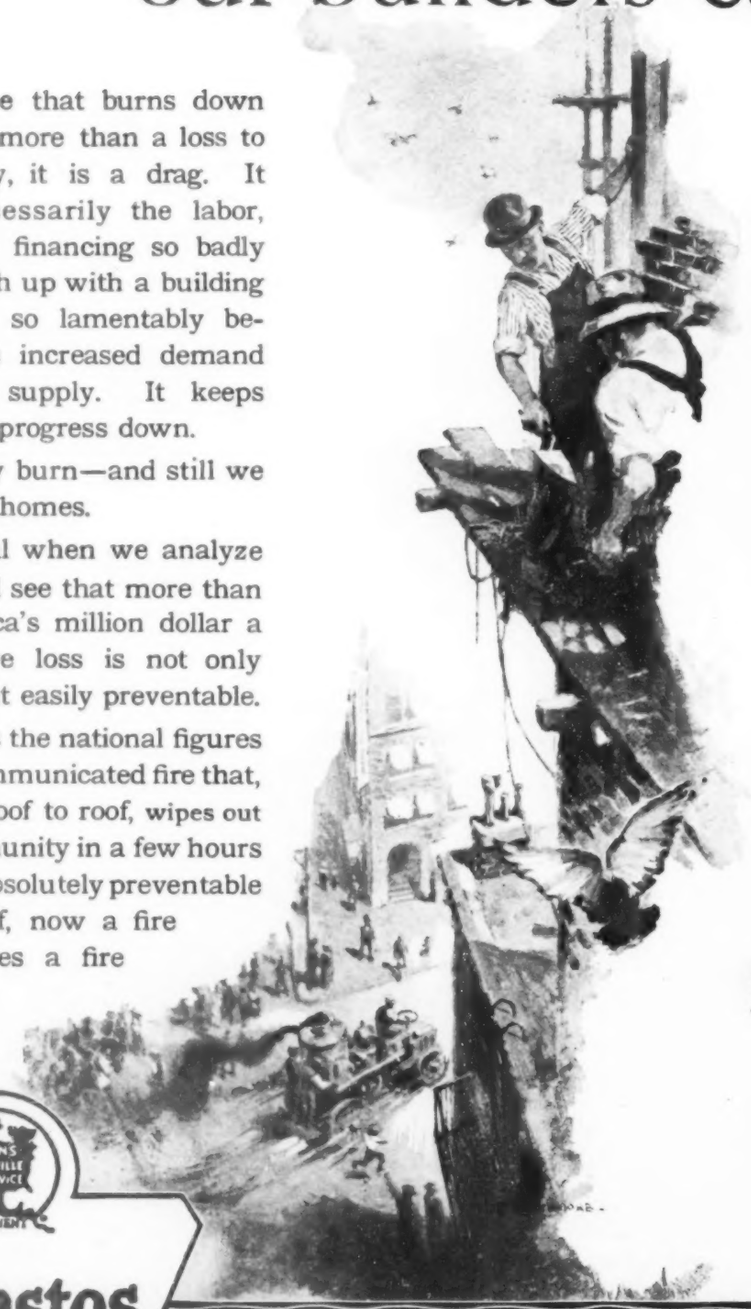
But Fire is working faster than our builders can



THE house that burns down to-day is more than a loss to its community, it is a drag. It diverts unnecessarily the labor, materials and financing so badly needed to catch up with a building program now so lamentably behind. It puts increased demand on restricted supply. It keeps prices up and progress down.

Yet still they burn—and still we need a million homes.

It's shameful when we analyze the figures and see that more than half of America's million dollar a day steady fire loss is not only preventable, but easily preventable.

What makes the national figures so big? It is communicated fire that, leaping from roof to roof, wipes out an entire community in a few hours—and *that* is absolutely preventable—for your roof, now a fire hazard, becomes a fire barrier the moment you make it all-mineral—Johns-Manville Asbestos.

And what is more, it gives you an *economical* roof.

You naturally associate Johns-Manville asbestos with fire resistance, but bear in mind that the same qualities that give it rock resistance to fire also provide it with rock resistance to decay—a double saving by simply putting on a Johns-Manville roof instead of the inflammable kind.

JOHNS-MANVILLE, Inc., Madison Ave., at 41st St., N.Y.C.
Branches in 64 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE, Ltd., Toronto

NOT only is Johns-Manville Asbestos the all-mineral roof—but also the all-purpose roofing.

—in built-up form for flat roofs.
—in ready roll form for sloping roofs.
—in corrugated form for roofing and siding.
—in shingle form for dwellings.
—all approved by the Underwriters' Laboratories, Inc.
—and all sanctioned by the hundred or more cities and towns that have ordinances against inflammable roofs.

JOHNS MANVILLE SERVICE
COVERS THE CONTINENT

Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Serves in Conservation

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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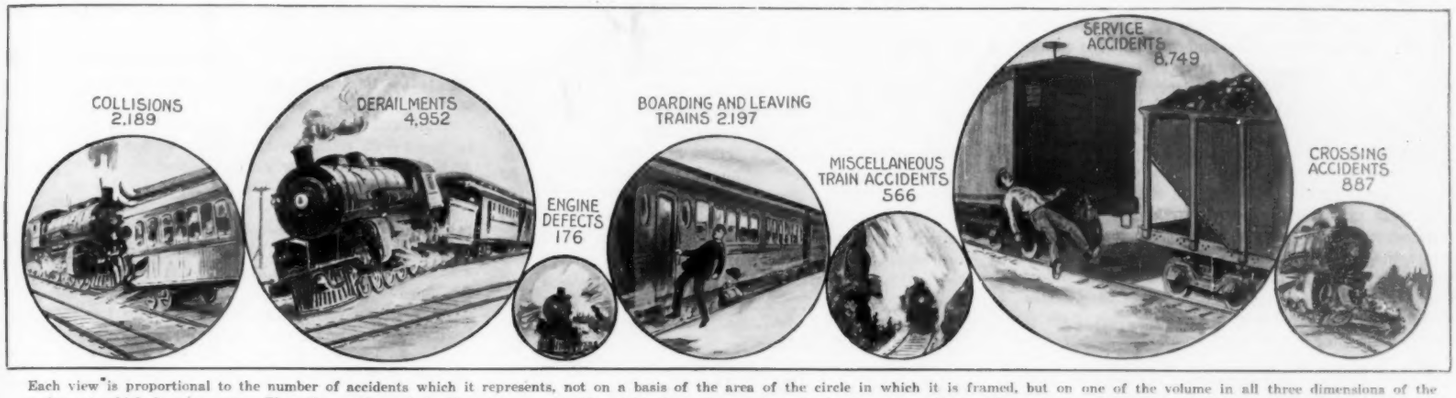


Each view is proportional to the number of accidents which it represents, not on a basis of the area of the circle in which it is framed, but on one of the volume in all three dimensions of the equipment which it represents. Thus the number of derailments was, roughly, eight times the number of miscellaneous accidents. To make the aggregate bulk of this view eight times that of the smaller one, the diameter of the circle in which it stands is, therefore, double that of the other

Three months' railroad accidents of all degrees of gravity, classified according to causes and numbers

Railroad Accidents and How They Work

By Ralph Howard

THAT a lot of people are killed by a lot of accidents on our railroads each year is of course well known to all of us; and that some at least of this is unavoidable may be conceded. It is however interesting in all ways, and surprising in some, to make a survey of the numbers, causes and results of these accidents. The figures which are set forth in graphic form on this page are those of the Interstate Commerce Commission covering railroad accidents for a single quarter of 1920. These figures are presented by the Commission in considerably more detail than in our drawings; we have combined minor classifications quite freely in the effort to group railroad accidents under a few comprehensive general headings.

It must be explained in the first place that we are not to feel too pessimistic over the statement that in three months we had 19,716 railroad accidents—an average of over 200 per day. A British army officer, in explaining to us the catastrophically high ratio which British casualties during the war bore to the total British population, reminded us that if a man scratched his finger on a button in putting on his uniform in the field, he was required, under heavy penalty, to report and undergo treatment for infection; and that this made him, statistically speaking, a casualty. Doubtless there are men in the British service today who have been casualties a score of times and who bear not the slightest trace of any of these "disabilities." In quite the same way, the definition of a railroad accident is extremely broad, so that thousands of entirely trivial occurrences get thus reported with respect to trains whose passengers have not been aware of anything out of the ordinary.

Nevertheless, taking the totals at their face value, we find some interesting conclusions to be drawn. Nearly half the total falls under what the Commission designate as "service accidents." A casual acquaintance with the details of railroading will picture to the reader the mishaps of switching, coupling, shop work, train unloading, etc., etc., which go into this category. It will be appreciated that seldom, if ever, are these accidents of direct interest to the passenger, except in the cases where they affect the departure of his train by delaying the making-up of the equipment or the arrival of the engine.

Of second and third degree of frequency are the accidents of the sort with which the passenger is best acquainted. Against 8,749 of the accidents that involve the railroad man alone, we find in the three months under consideration that there were 4,952 derailments and 2,189 collisions. As a matter of fact, accidents incurred in boarding and leaving trains attained a tiny preponderance over collisions in point of numbers alone, being as 2,197 to 2,189; but in view of the usually more serious character of the collisions, and the very close equality for all practical purposes in point of numbers, we may fairly classify the collisions ahead of the others.

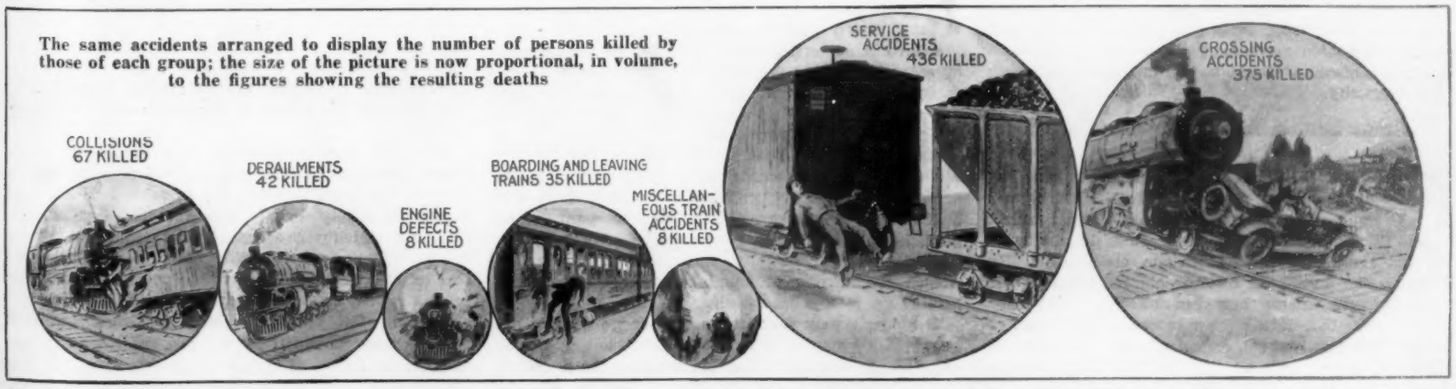
Fifth in the order of frequency are the crossing accidents, for which ordinarily the railroad is not to blame. There were 887 of these, or nearly 10 a day—which is anything but a testimonial to the automobiling public and to the liberality with which grade crossings have not been eliminated. Finally, we have 176 cases of accident due to engine defects, and a miscellaneous category of 566 accidents to trains, the nature of which might fairly well constitute a considerable strain upon the imagination after ruling out all the specific categories which we have listed. We do not know whether an accident caused by a train's getting mixed up with a landslide would count in the Commission's reckoning as a miscellany or as a case of derailment; but it is the best approach to a miscellaneous train accident we have been able to picture so we have used it to stand for this group.

If we reduce the thing to percentages, we find that of all railroad accidents, large and little, during the quarter, 44 per cent were service accidents, 25 per cent were derailments, 11 per cent were mishaps to persons boarding and leaving trains and the same proportion were collisions, 4½ per cent were crossing smash-ups, a shade under 1 per cent were engine failures, and some 3 per cent were miscellaneous in character.

If we try to distinguish the serious accidents from the trivial ones, we must give up the test of frequency and adopt that of fatality. We find that here again the service accident heads the list, having taken the lives of 436 persons in three months. These were in practically every case, of course, employees, since the innocent bystander who might get killed in such a mishap would be classed as a trespasser and refused a place in the record. But second place in this listing

(Continued on page 257)

The same accidents arranged to display the number of persons killed by those of each group; the size of the picture is now proportional, in volume, to the figures showing the resulting deaths



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Our Attitude Toward the Port and Harbor Plan

IN view of our criticism last week of the proposed 200-million-dollar, food-and-merchandise tunnel beneath the Hudson River, we wish to make it clear that, with the exception of the tunnel part of the problem we give our hearty endorsement to the report of the Commission. As we stated last week, the report is comprehensive and masterly. The proposals to build three systems of railroad belt lines; to reorganize the water fronts by doing away with the existing railroad terminals and releasing these water fronts for their legitimate use as terminals for river and ocean shipping; the deepening of the harbor channels; the provision of terminal piers and grain elevators for the Barge Canal; the reconstruction of the pier system so as to bring it thoroughly up-to-date, with wide piers, double-deck pier sheds, and an equipment of modern freight-handling machinery; the provision of sufficient dry docks and repair plants; and the zoning of steamship service so that those which serve particular trade routes may be grouped together; all of these and other recommendations of the Port Commission are in every way admirable and should receive the enthusiastic support of both the City of New York and Jersey City.

What we do claim is that the one serious defect in the report is the very limited and extremely costly plan which it offers for connecting New York and New Jersey. The provision of two single tracks, costing, with the accessory yards and distributing stations, some 200 million dollars, is a plan that is at once as inadequate as it is extravagantly costly for the service that it could render. For thirty years past this journal has been a strong advocate of a single great bridge, double-decked and of enormous capacity, as the only means of adequately connecting up Manhattan Island with the mainland on the Jersey side. If the Joint Port Authority is to be authorized to spend 200 million dollars, let that money be put into the construction of the belt lines, the reconstruction of the piers along the various water fronts, and the other improvements suggested by the Commission. Meanwhile, plans for a bridge have been prepared, the funds for its construction are available, and the whole thing can be put through contemporaneously with the belt system, pier improvements, etc., without either of the two states or the cities concerned having to contribute a single dollar from their treasuries.

It is most important to make the right start in this matter, which should have been solved several decades ago. The very first thing to be done is for the States and Municipalities to sink their local differences and realize that the reorganization of the port through which one-half of the Nation's foreign trade is handled, is a question of City, State and Federal concern and should be treated accordingly. The first step toward this reorganization should be the creation of a single Port Authority.

Great Britain Adopts the One-Power Standard

GREAT BRITAIN announces that she has adopted a one-power in place of her former two-power standard. She has taken the first step to this end by scrapping those of her dreadnaughts that are armed with the 12-inch gun, eight in all. By doing so she makes yet another big reduction in her naval strength. As we showed in our issue of February 12, 1921, she lost during the war over 600,000 tons of her fighting fleet, and subsequently to the war scrapped the whole of her pre-dreadnaught fleet. The elimination of these eight ships brings her strength in battleships very close to the level of our existing battleship fleet.

This momentous change in policy was made known in Parliament by Lord Lee, First Lord of the Admiralty. In announcing the naval estimates for the next fiscal year, he said: "The Admiralty have effected drastic economies and have agreed to assume risks which in ordinary circumstances they would regard as difficult to reconcile with a full maintenance of the Government's declared policy." He stated that the economies included a reduction in the number of capital ships in full commission from twenty to sixteen, as compared with thirty-eight in 1914, this being the smallest number that would enable the essential seagoing technical training of officers and men to be carried out properly.

With regard to the smaller units; cruisers, destroyers, et cetera, the Government has decided to place in reserve one of the four destroyer flotillas of the Atlantic fleet; to withdraw completely the South American squadron; to reduce the North American and South African squadrons by one light cruiser each; and to reduce the personnel of the fleet to 121,700 men. Since this total includes the marines, it is probable that the total enlisted strength in seamen will stand at about the figure we quoted some weeks ago, say, 100,000 men.

These changes, he announced, will leave a total of thirty battleships and battle-cruisers on the effective list, of which number sixteen will be in commission and fourteen in reserve. The effective fleet then will consist of twenty-two battleships and eight armored cruisers. Of the battleships, ten carry the 15-inch gun and twelve the 13.5-inch gun. Of the armored cruisers, three mount the 15-inch gun, three the 13.5-inch, and two, the "New Zealand" and "Australia," are of an obsolescent type, armed with the 12-inch gun.

Referring to the older ships, the First Lord stated that they cannot much longer be reckoned as efficient fighting ships, and hence the sum of $12,500,000 is to be devoted to replacement. This sum will not go very far in these days of high cost of construction, since it represents less than one-third of the cost of a single ship. Probably it will be expended on the preliminary work on a new type of ship, in which the experience gained with the battle-cruiser "Hood" will be embodied.

Plea for a Naval Conference

EVERY thoughtful student of the present crisis in international affairs must feel the force of the plea which the First Lord of the Admiralty has made for an amicable agreement between the United States and Great Britain on the question of naval strength. His address, which was made at a gathering of the Institution of Naval Architects on the day succeeding his announcement of the reduction of British naval strength, was devoted to the broader, international aspects of naval policy. Referring to the fact that both navies have now separately announced their intention to maintain a one-power navy, that is to say, a navy equal to that of any other, he elaborated the question in words which are so full of common sense and candor, and so admirably express the attitude of conservative opinion on both sides of the water, that we quote them in full.

Referring to the remark of Secretary Denby that the greatest calamity which could overtake humanity would be a war between Britain and America, and that between them they could control the sea, he said: "I have no doubt that between us we could; but the question before us today is whether we are heading in the right direction without consulting with each other. We have in our estimates of this year set an example of reduction. We have admittedly taken risks as regards the relative position of our navies and of others, and we are prepared to go as far as possible in that direction by mutual agreement.

"In that respect I think the Government of this country has a clear record; but merely to talk of hands across the sea is not sufficient. We must have our heads across the sea as well. . . . What we want is that plain horse sense which is characteristic of both our countries, and, personally, from long knowledge of America, I have a profound belief in business talk leading up to a square deal.

"I hold strongly that in this matter we are not engaged in a game of poker or of bluff, but a sort of game where we ought to lay our cards on the table and discuss frankly with our friends what the future should be. The only point that remains to be settled is who is to make the first move to initiate the discussion. Still, we are not disposed to stand upon ceremony in this or any other matter.

"We welcome the hint which has been thrown out by President Harding and it will continue to be met with a most cordial and helpful response here. I can say this, that if an invitation comes from Washington, I am prepared personally to put aside all other business, pressing though it may be, in order to take part in a business than which there can be nothing more pressing in the affairs of this world."

The conference, here so frankly welcomed, should be held at once, and it should take place in Washington, far from the distracting atmosphere of European politics.

The Diesel-Electric Drive for Ships

FOR the first half-century of the development of the marine engine, the reciprocating engine held the field most worthily and gave magnificent service. Its first serious competitor was the steam turbine, and when once the new drive had established itself as both reliable and a saver of fuel, its progress was so rapid that for use in passenger ships it soon promised to monopolize the field.

But the steam turbine suffered under the disadvantages that the most economical speed for the turbine was the least economical for the propeller; and it was not until the mechanical-reduction gear (which in the motive power of a turbine-driven ship serves in some respects the same purpose as the transmission gear of the motor car) was introduced, that the turbine came into its own and achieved an economy superior to that of the best reciprocating engine.

When the mechanical-reduction gear made its appearance, the electrician was quick to see that reduction of the speed of rotation between the turbine and the propeller could be accomplished electrically with as much and perhaps more efficiency than it could by mechanical gearing; and so there appeared the electrical steam drive which has made such gratifying strides during the past few years. To our Navy Department goes the credit for testing out and establishing the merits of this system, which they did first in the 7,000-horsepower collier "Jupiter," and then in the 30,000-horsepower battleship "New Mexico." So well convinced is the Bureau of Steam Engineering of the Navy of the superiority of this system over any other that practically the whole of our new Navy will be equipped with this drive.

But the steam mechanical-reduction and the steam electrical-reduction drives are by no means destined to have the competition exclusively to themselves; for during the later years of the development of the steam turbine, yet another competitor has been steadily, if rather slowly, coming forward in the form of the heavy-oil, or Diesel engine. Theoretically, this is more economical than any of the foregoing, and the difficulties which have delayed its application on a more widely-extended scale have been almost purely mechanical. The development in this field has been in some respects fairly parallel to that of the early growth of the reciprocating steam engine, and particularly in respect to the steady increase in the size of the individual cylinder and the power that can be developed therefrom. Thus, nearly all of the Diesel-engine marine installations at the present time are of the reciprocating direct-drive type, with the engine and the propeller upon the same shaft; and in the larger units we have massive reciprocating engines running at a slow speed of revolution—in other words, we have a situation roughly analogous to the marine reciprocating engine before the advent of the turbine and reduction gear.

But in the marine oil engine, as in the steam engine, there is economy in using a high speed of rotation, and hence it was inevitable that the Diesel engine interests should ultimately seek to gain for that type all the economies which were secured by the steam engine from the introduction of reduction gear, whether mechanical or electrical. That day has now come, and the results which have been gained with the first installations of this character have been so encouraging that we may confidently look for a great development in the near future of the Diesel-electric drive.

Astronomy

The American Astronomical Society will hold its next meeting at the Van Vleck Observatory, Wesleyan University, Middletown, Connecticut, from Aug. 30 to Sept. 2, 1921.

Solar Eclipses.—Apropos of the annual eclipse of April 8, 1921, Dr. Crommelin writes in *Nature* that the occurrence of a central solar eclipse within the limits of the British Isles is a rare event. There has been no British total solar eclipse since 1724, and the next one will occur in 1927, if we disregard that of Jan. 24, 1925, in which the track of totality merely grazes the Western Hebrides and the eclipse occurs with a very low sun. The last annular eclipse before that of the present year was in 1858 and there will not be another until 2093.

A Catalogue of Radial Velocities.—Many observatories have lately pushed forward the work of measuring the velocities of stars in the line of sight by the well-known spectroscopic method, and a large collection of data on this subject has just been published by J. Voute, of Java, under the title "First Catalogue of Radial Velocities." It gives radial velocities of more than 1,900 stars and 148 nebulæ and clusters, together with information concerning the observatories where the measurements were made, and the magnitude, proper motion, spectrum type, and galactic latitude and longitude of each star. Parallaxes are also given when known.

A Large Collection of Meteor Observations. — The Leander McCormick Observatory of the University of Virginia is now publishing a work containing the results of 22,000 observations of meteors made during the years 1914-1918 by the members of the American Meteor Society. This publication contains more observations of meteors, discussed in a scientific manner, than any ever before issued. The Society is seeking the general coöperation of astronomers in the task of securing reports of the magnitudes of telescopic meteors. There has been a considerable revival of interest in meteors lately, both in this country and abroad. A Committee on Meteors has been appointed by the International Astronomical Union, with W. F. Denning as chairman. Photographic methods of observing meteors are being tried in England.

A Lunar Formation on the Earth.—Prof. K. Stoeckl, writing in *Die Himmelswelt*, describes an interesting terrestrial counterpart of the bright rays which, at full moon, may be seen extending to great distances from some of the lunar craters, especially Tycho. A common explanation of these rays is that the moon, while cooling, had its crust broken in numerous fissures, which were later filled up from beneath by molten material of high reflecting power. The writer finds something very similar in the so-called pile formation in the old mountain mass along the Bavarian-Bohemian boundary, especially at Pfahl, in the Bavarian forest. This formation extends in a straight line from Roding to the Bohemian border, near Klafferstrass, a distance of about 150 kilometers. The white rock of the Pfahl quartz can often be found in pure form, and if the earth were observed from the moon this filled fissure, wherever it appears on the surface, would doubtless be seen as a white streak, on account of the high reflecting power of the white rock under a high sun.

Another Comet Scare.—From time to time the columns of the newspapers are enlivened with reports that the earth is in imminent danger of collision with a comet. Alarming rumors of this sort, it will be recalled, attended the last visit of Halley's comet, and now it is the Pons-Winnecke comet that is about to annihilate us. Sensational announcements on this subject having been erroneously credited in the press to Greenwich Observatory, Dr. A. D. C. Crommelin of that institution takes occasion to deny them in the *Journal* of the British Astronomical Association. As to the chances of collision between the nucleus of the comet and the earth, he says that the uncertainty of the comet's distance from the sun at nodal passage is quite half a million miles; the chance is, therefore, 1 in 60 that it falls within a particular 8,000 miles (the earth's diameter). Next, the comet's resolved velocity perpendicular to the ecliptic is about 8 miles per second, which would mean ⅛ hour for 8,000 miles. Now, as the possible range of perihelion passage is some 400 hours, the combined chance of collision with the head is 1 in 60 x 1,200, or, say, 1 in 70,000. If we assume for the coma a diameter three times that of the earth, we should multiply the chance by 16, but it would still be only 1 in 4,000. Collision with the coma, says Dr. Crommelin, would probably almost escape notice, while even if the head were encountered there is no reason to anticipate anything more than a great meteor shower.

Science

Dr. Priestley's Air Pump.—The air pump used by Dr. Joseph Priestley, the discoverer of oxygen, has been presented to the Franklin Institute by Mr. Coleman Sellers, Jr., and Mr. Horace W. Sellers.

The Wettest Spot.—The summit of Mount Waialeale in the Island of Kauai (Hawaiian Islands) had a rainfall of 590 inches in thirteen months. The mountain is 5,080 feet high and is exposed to the prevailing trade winds.

A Bathtub Census.—Boston has had a bathtub census! In 1880 there were 40.2 persons for each bathtub and in 1920 the use of tubs had increased to such an extent that there was a tub for every 4.4 persons. This is certainly a victory for sanitary science even in the "Hub."

Germany Bedeviled by Occultism.—An unprecedented wave of occultism is sweeping Germany. Card readers, mediums, astrologers and all the motley crew are opening up everywhere and are doing a land-office business. Large numbers of pseudo-scientific societies to study spiritualism, astrology and other phases of occultism are being organized.

Our National Bonfire.—Fires in the United States in five years have destroyed property worth nearly $1,500,000,000. Electricity is given as the chief cause of fires, with "matches-smoking" second; defective chimneys and flues, third; stoves, furnaces, boilers and pipes, fourth; spontaneous combustion, fifth; lightning, sixth; sparks on roofs, seventh; and petroleum and its products, eighth.

Psychological Effect of Colors on Prisoners. — The officials of a penitentiary are trying a new experiment by repainting the four cell-blocks and allowing each prisoner to select the color he likes for his own cell for psychological effect it has upon the malefactor. The corridors of the cell-houses are being painted a light brown. The cells are being painted in attractive tints of yellow, blue, brown, buff, etc. None of the cells, the warden explained, is to have somber settings but are all to be bright and cheerful. The penologist is always an optimist.

Mustard Gas Routs Crooks. — Three bank robbers were routed by mustard gas in a Michigan bank. Tubes of the gas had been placed in the bank vault a few days before as a precaution against bandits. When the yeggmen blew in the doors the tubes burst and the thieves fled, leaving 85 cents of their own money and an expensive kit of burglars' tools behind them. It was several hours before the building could be entered with safety. Only the first door of the big vault had been blown away, the escaping gas defeating the purpose of the yeggmen.

Extension of the Finger-Print System to the Pores.—An important adjunct to crime-detection is reported from Paris. This new plan supplements the Bertillon system of measurements and finger-prints. It has been found that a man can be traced not by finger-prints alone but by marks on any part of the body. Any of the pores of the skin may be employed. This is the discovery of Dr. Locard, head of the French Police School at Lyons. Criminals often use gloves to foil detectives, but the forearm, or the elbow may give a print equally as valuable for identification.

One Interview in 110 Years.—The Dalai Lama of Lhasa in Tibet has just given an interview to an electrical engineer. This is the first time that a Lama has talked with a European in 110 years. Lhasa is on a plateau, 11,000 feet high which is perhaps desirable as sanitation is non-existent. Tibet seems to want telegraphic communication with the outside world and there are faint signs of an industrial awakening. Mr. Fairley, a telegraph engineer, had an audience with "His Holiness," who proved to be kindly and very inquisitive. He also visited the Tibetan Council called the "Council of Shapes." A twenty-four course luncheon followed.

The Newcomen Society.—This new society has been formed in London for the study of the history of engineering and technology. The prospectus emphasizes the fact that engineers, inventors and manufacturers have served the world as well if not better than generals or politicians, yet their works are almost forgotten and their names are remembered by but a few. The history of engineering and technology has been, and is being, neglected, and the ambition of this new society will be to assist in supplying the deficiency. A journal is promised as well as a card index of published information. Anyone interested can join, the annual dues being one pound sterling. The headquarters are The Science Museum, South Kensington, London, and Mr. H. W. Dickinson is the Honorable Secretary as they term it in England.

Electricity

A Welder for the Small Job has made its appearance in the form of a 100-pound outfit, which is intended to accomplish any work in and around a garage, plumbing shop, machine shop, and so on. The machine uses electrodes from 1/16 inch to 5/32 inch in diameter, and will operate continuously with the medium and small sizes and intermittently on the large size.

A Georgian Radio Station is shortly to be erected for the purpose of communicating within a radius equivalent to the distance between Tiflis and London. The new station will connect Georgia with large European centers, such as Paris, London, Rome, Moscow and others. Part of the same project calls for the erection of four radio telephone stations in various parts of Georgia, the central station to be located in Tiflis. Georgia is in the Caucasus.

Our Telegraph Industry.— According to the U. S. Bureau of the Census, there are twenty-one telegraph companies operating in this country with a total pole line of 241,012 miles and 1,888,793 miles of single wire. More than 155,000,000 messages are transmitted each year. For the convenience of customers 28,865 offices are scattered over the country. A total of 39,000 employees receive salaries amounting to nearly $40,000,000 annually.

Siasconset Radio Station.—A new radio station has been opened by the International Radio Telegraph Company at Siasconset, on Nantucket Island, Mass. Current for operating this plant is obtained from a storage battery, which is charged when necessary by means of a gasoline-driven generator set. The transmitter is of the spark type, and of two-kilowatt capacity. It may be operated as a quenched-gap or rotary synchronous spark gap transmitter.

The First Wireless Detector.—In a letter sent by Prof. A. Turpain of the University of Poitiers in France, the professor states that he was the first to insert a telephone in the discharge circuit from a Hertz resonator. His experiments were conducted two years before Marconi began his work, and they are described in a recent issue of *Revue Générale de l'Electricité*. He reports hearing the noise of the discharges in the telephone receivers, although the spark was 30 yards away, with four thick walls intervening.

An American Radio Record was scored by the U. S. Navy when the Goat Island radio station reported that messages had been sent within three minutes from Cavite, Philippine Islands, to Washington, D. C., a distance of 10,000 miles. The Cavite station sent test messages 7,000 miles to the Goat Island station. The messages were forwarded to San Diego and thence to Washington. It is said that the new automatic control, which was used in making the record, eliminates all handling of messages between originating and receiving points.

A Compact Electrically-Driven Water Supply System has been developed by a Western manufacturer in order to afford the convenience of running water wherever electric service is available. The system may draw its supply from a well, cistern, lake or stream and provides a steady pressure with but a small amount of attention. A rotary pump with a capacity of 300 gallons per hour is directly connected to the motor. A cast-iron pressure tank acts as a reservoir and serves as a base for mounting the motor, pump and control equipment.

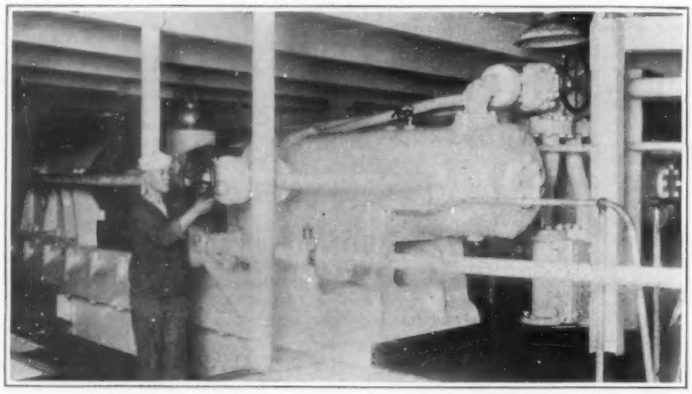
A Condensed Heating Unit that may be inserted in the pipe outlet of any vessel for the purpose of heating water or other liquids is among the latest heating appliances. This unit is inserted through the walls of the vessel below the minimum liquid level, and as many units as are necessary may be used to raise the liquid to the desired temperature. Each unit consists of nickel-chromium wire covered with mica and enclosed in copper casings which are slipped into closely fitting copper sheaths. The heater is made in different capacities from 500 to 4,500 watts.

Radio Cable for Guiding Ships. — From a recent issue of *Comptes Rendus* we learn that in the summer of 1919 experiments were conducted on a large scale at Brest with the method of guiding ships through fog by means of a single-pole cable carrying an alternating current of audible frequency. The cable current was about 2.5 amperes, and the ships were provided with four 3 x 8-foot coils with sixty turns each and with different orientation in the ship. The coils were directly connected to telephone receivers, and we learn that the sound could be distinctly heard more than a mile from the cable. In the American application of the radio cable a vacuum-tube amplifier has been employed in conjunction with the telephone receivers as already described in our columns.

The Electric Battleship

Features of the U. S. S. "Tennessee" Designed from First to Last for Electric Drive

THE U. S. S. "Tennessee" is the first battleship to be specifically designed for electrical propulsion. The "New Mexico," though the first electrically-driven capital ship, was originally intended for turbine drive and was changed over during the course of construction. But the designers of the "Tennessee" had the electric system in mind from the very beginning and were, therefore, able to utilize the possibilities of this drive to the fullest extent. Consequently the "Tennessee" must be regarded as the type ship of our electrically-propelled capital vessels; and the value of electric drive, from both the military and the engineering standpoints, must be judged mainly by her performance.



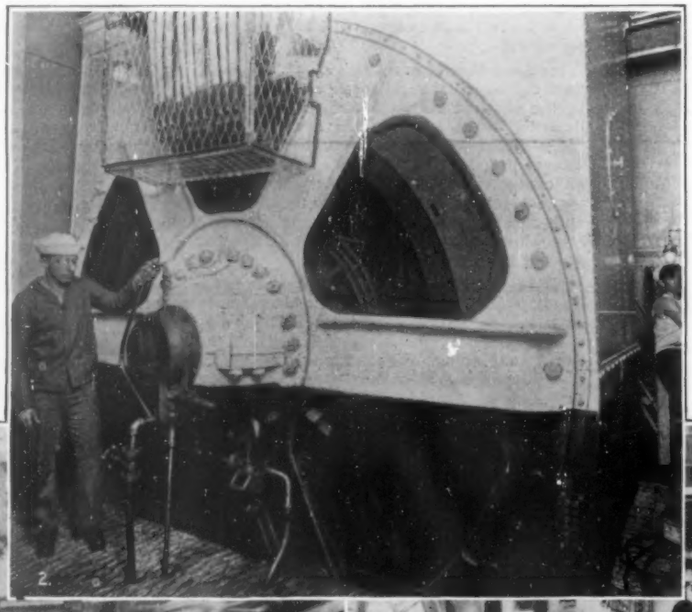
Hydraulic cylinders which move the rudder of the "Tennessee," controlled through small oil pipes leading from the bridge and other steering stations

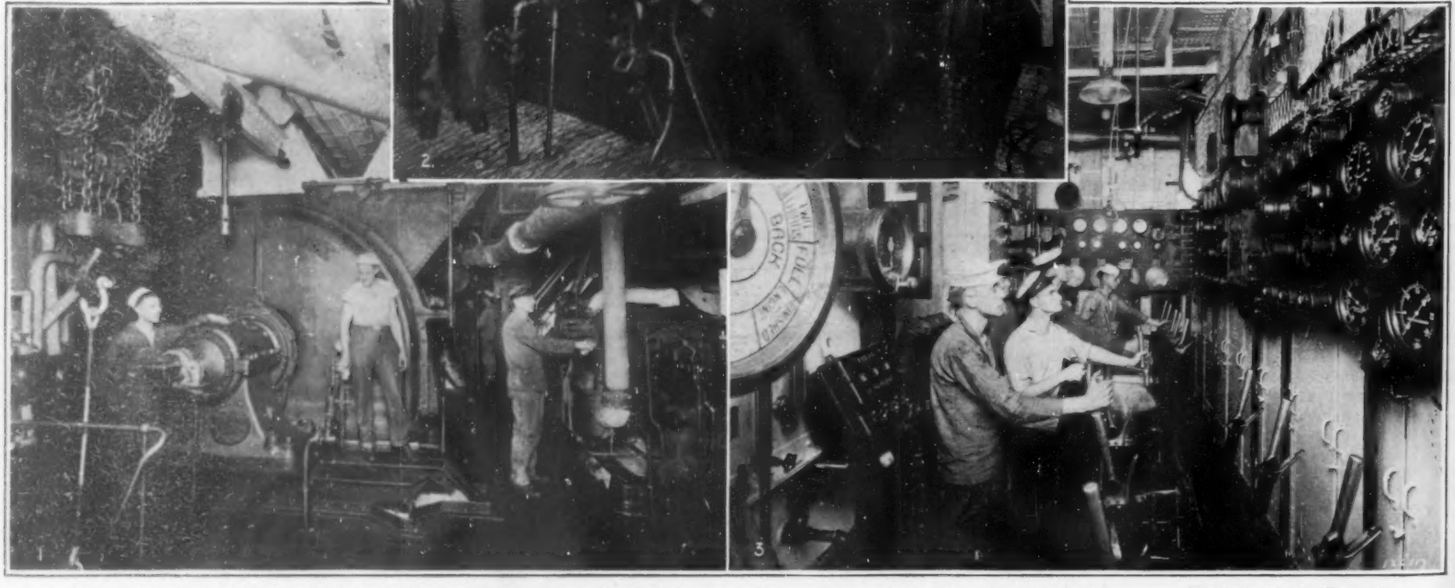
One of the most interesting of the features of the "Tennessee" made possible by her drive is the extreme subdivision of her interior. She is literally a vast honeycomb, and her compartments are not only presumptively water-tight, but actually so. No means whatever have been provided for horizontal inter-communication between compartments, and if one wishes to pass from one to another, he is compelled to climb up to the gun deck and then descend again. There is, therefore, no possibility of leaving bulkhead doors open, nor are there weak points in the bulkheads that can be burst open by water pressure. Because of this construction, it is believed that the "Tennessee" can be struck below water line, perhaps repeatedly, by torpedo, mine, or shell without being put out of action. That this extensive subdivision has not been carried out in the case of the "New Mexico" is shown by the fact that the generators, inboard motors, controllers, and auxiliaries are all in one room, whereas on the "Tennessee" there are separate compartments for each generator with its auxiliaries, each outboard motor, the two inboard motors, and the control station.

Another unique detail of the "Tennessee's" design is the concentration of the control of her propelling machinery at one point. In the "New Mexico" the various controllers are scattered throughout her machinery space, but in the "Tennessee," practically all of the controls of her main generators and motors are located in a row down the center of a single narrow compartment, which is placed in the most protected part of the ship. The turbine-control valves and the levers for operating the generator field switches are placed in the center of the lever group, while the levers for controlling the after-generator and the port motors are on the left, and those for the forward generator and the starboard motors are on the right. In front of these levers is a set of meters giving complete information in regard to the various machines concerned with propelling the ship, and behind the levers are the telegraphs and other means of communication with the bridge. This concentration of control appears to be an ideal arrangement, and it should prove to be an important factor in increasing the all-around efficiency of the ship.

The "Tennessee's" main propelling machinery consists of two 15,000 kva. Westinghouse turbo-generators and four 8,000-hp. propeller motors. The system is similar to that of the "New Mexico," except that the current generated is 3-phase instead of 2-phase; the speed of the turbines is controlled by hydraulic instead of mechanical governors; and there are certain differences in the switching system. There will probably be considerable discussion among engineers as to the merits of these changes, but in general the equipment of the "Tennessee" can be regarded as an advance on that of the "New Mexico."

On the "Tennessee's" trial trip last fall, trouble was experienced due to the grounding of the field coils of one of the main generators. This accident was purely mechanical in its nature and the damage was easily repaired, although the construction of the ship made the removal of the field difficult. The electrical performance of the ship was entirely satisfactory. She is now at sea again and information concerning her performance is awaited with interest.





1.—General view of one of the two duplicate engine rooms, showing one of the 15,000 kva. generators. 2.—Forward end of one of the four 8,000 horsepower Westinghouse propeller motors. 3.—The general control room, placed in the center of the hull, below the protective deck. This is the nerve center of the whole ship

The electric propelling machinery of the battleship "Tennessee"

Measuring Light Reflection

THE Bureau of Standards, in Scientific Paper No. 405, has developed a simple, portable instrument for the measurement of reflection and transmission factors in absolute units. A small integrating sphere, with a small segment cut off, has been adapted for attachment to a portable photometer. The opening in the sphere is placed over the surface to be tested, so that the test surface completes the surface of the sphere. A small beam of light from a low voltage lamp is projected through another small hole on to the test surface at an angle of about 40° from the normal. It can be rotated so that it is incident on the sphere surface at another point instead of the test surface. Photometer readings are taken with these two conditions, and the reflection factor of the test surface is the numerical value of the ratio of the brightness of the sphere wall in the two cases. The paper describing the instrument is now ready for distribution, and anyone interested can obtain a copy by addressing a request to the Bureau.

Saving Coal by Reducing Power Costs

NOT unlike the human brain in function is the novel device recently installed in the engine room of one of New York City's largest hotels. In a manner the device is the brain of the hotel, or at any rate one of its vital nerve centers.

The contrivance is a large instrument board, on which have been assembled thirty-three measuring and recording instruments, all of which take part in intelligently regulating, from this central station, those engine-room activities so essential to the comfort and safety of the hotel's twelve hundred guests. Most of these various instruments are in use separately in engine rooms, but in scattered places; the novelty of the plan lies in using instruments of the recording type to cover so many important branches of a power plant and in assembling them in one place for convenient observation and comparison.

At this board there will be stationed, during every hour of the twenty-four, a watch officer, whose duty it will be to keep track of the records made by the instruments, which will show varying conditions with respect to the heating, ventilating, generating, refrigerating, water supply systems, etc., and when conditions go beyond certain limits the watch officer will notify the man in charge of that particular department, who will take the necessary action. The man who has charge of the board will be able to tell not only just how things are at a particular moment (the old-style instrument would tell him that much) but he will be able to tell in addition the condition of affairs during the entire watch just previous to his and will thus be able to govern himself accordingly. This is made possible by the fact that each instrument has on its face a recording card on which the record is automatically set down, as it is on the well-known recording thermometer. These records will thus be available at any time to the chief engineer or to the management of the hotel and may be filed for future reference. They will undoubtedly furnish valuable data for computing accurately operating costs, etc.

This instrument board is expected to help not only in operating the hotel more efficiently and to the greater comfort of the guests, but will likewise prevent waste, particularly waste of coal, a most important advantage, in view of the high price and scarcity of that essential commodity. For the whole matter of power, whether in the form of heat, light, steam, electricity, etc., reduces itself to the problem of the all-important coal bin, and if more energy, in any of these forms, is used than is necessary to produce desired results, just that much coal is wasted. For this reason the great saving of coal that this device will effect should recommend it to all hotels, office buildings, or other establishment where power, heat, light, etc., are required.

This board will act as a constant check and reminder; consequently there will be no excuse for a man's overlooking to do certain things that he ought to do. For instance, supposing that, under the old system, the temperature outdoors, in the morning, is such as to require a certain pressure of steam in the heating system of the hotel to make milady comfortable. The requisite pressure is turned on. Later in the day, however, the temperature outdoors rises. But the man in charge of the heating apparatus in the boiler room, having other duties to perform, may forget to keep track of the temperature outdoors. Consequently the amount of steam sent through the radiators is not reduced. As a result more heat is used than is necessary and this condition may continue for hours, unless somebody in the hotel—a guest perhaps, or an employee—complains about the excessive warmth. During all this time heat, and consequently coal, has been wasted. Under the new system this waste will be prevented, because a glance at the instruments "temperature outside" and "temperature in building" will tell the man in charge just what needs to be done.

Again, under specified conditions, exhaust steam is used for certain heating purposes and under other conditions live steam is employed. The use of the latter when the former would do the work of course results in waste, which the board will prevent. Once more: In every engine room there is a device for "blowing off" the boilers; that is, for ridding them of sediment. As this is done only once a week there is always the possibility of the job's being overlooked, with conse-

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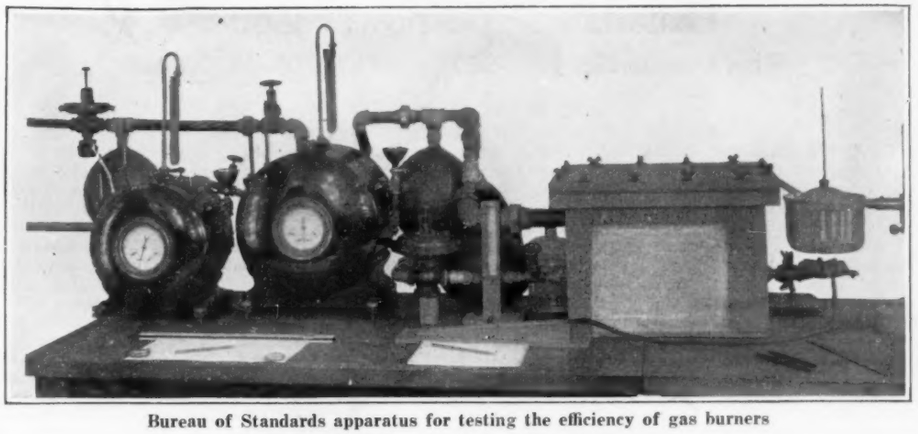
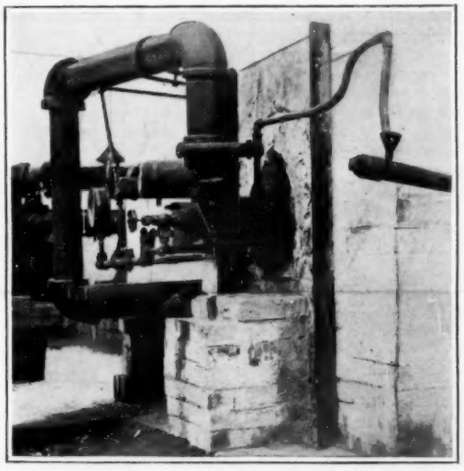
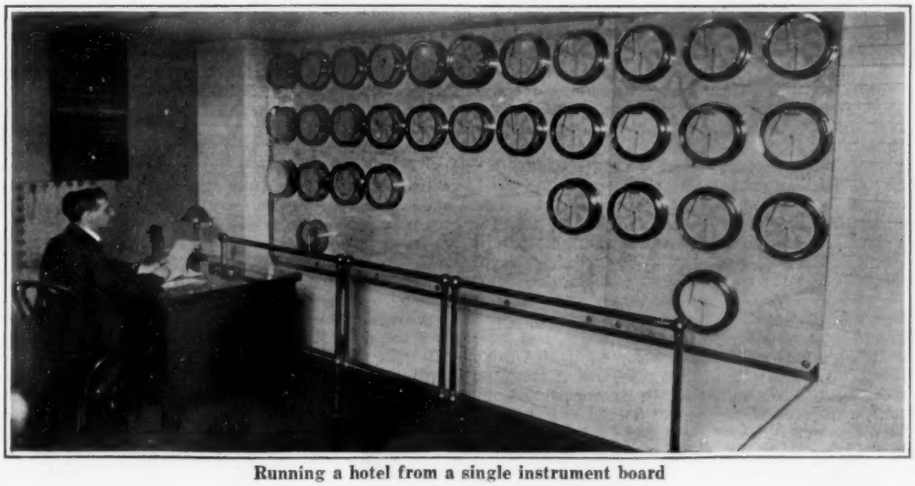


Bureau of Standards apparatus for testing the efficiency of gas burners



View of one end of the phosphoric-acid furnace, showing water-cooled oil-burner and slag holes



Running a hotel from a single instrument board

Keeping Check on Gas Burner Performance

DISTINGUISHED as the first apparatus of its sort, the U. S. Bureau of Standards has designed suitable equipment for testing gas burners. If the laboratory arrangement—the result of 18 months' ceaseless effort — merits in practical application the claims for it in theory, a distinct contribution has been made to the study of how to increase the efficient use of gas. This statement is particularly applicable to the consumption of natural gas in domestic burners.

Specific tests have revealed the inability of gas appliances now in use to utilize any substantial percentage of the heat value of gas—only ten to thirty per cent. The possibility of enhancing the efficiency of the equipment to the use of thirty to fifty per cent is altogether feasible—by a readjustment of gas burners and in many instances the displacement of present-day appliances. A scientist of the Bureau of Standards is responsible for the statement that domestic burners leave scope for 100 per cent economy.

The principle employed by the apparatus developed by the Bureau of Standards for testing gas burners is that of determining by direct measurement the percentage of primary air which is injected by the gas under any condition of operation. The burner is first operated alone, the pressure being scientifically determined. The cover is then placed on a box, an essential unit of the laboratory equipment, and air is forced in through a meter until the previous pressure condition is duplicated. Readings of the air and gas meters reveal the relative volumes of air injected therein and gas consumed.

The photograph shows a 40-cubic-foot holder, into which gas is pumped, then passing through the wet meter into the burner. A "thirty-light" dry meter is used for measuring the air. To eliminate fluctuations

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Phosphates by a New Process

A NOVEL method for producing phosphoric acid for commercial fertilizer purposes, as evolved by the United States Bureau of Soils, has developed the use of crude oil as a heating agent in a special design of furnace which embodies the features of both the open hearth and the blast furnace. Inasmuch as crude oil is the most economical and readily accessible of fuels in the phosphate-mining areas of Florida, the government experiment has peculiar significance to the commercial fertilizer industry.

Two oil burners, one at either end of the furnace with an elongated hearth, play over and above the latter and through a central shaft containing the phosphate charge which is to be smelted. Safeguarding the ends of the burners from melting at the temperature attained, which is approximately 1,500 degrees Centigrade, are water jackets fashioned similar to those employed in cooling the tuyeres used in supplying hot blast to the blast furnace.

Government experts are hopeful of promising developments in the not remote future from the special type of furnace as well as the use of crude oil as a heating agent. Advantages of the new method over the old sulfuric acid way are already obvious, says the Bureau of Soils. To illustrate, only excellent quality phosphate rock containing a maximum of 4 or 5 per cent iron and aluminum oxides are now being used by the fertilizer manufacturers in producing acid phosphate.

Such a rigid requirement involves the use of an elaborate washing and screening process in assembling the rock from the phosphate beds of Florida. Necessarily,

(Continued on page 258)

Canada's Superpower Zone

What Ontario Has Done in Hydroelectric Development

By Robert G. Skerrett

CANADA has set the pace for the United States in the creation of what may properly be termed a superpower zone. Physical and economic circumstances forced this upon a section of the Dominion; and we have every reason to be interested in what our neighbors to the north have achieved in overcoming natural handicaps. The subject is all the more deserving of consideration on our part because of conditions that are gradually changing within our own borders, and especially in view of the proposed institution of a superpower zone in our northeastern Atlantic States.

The Provinces of Quebec and Ontario hold more than half of the population of the entire Dominion, and within their gates five-sixths of the country's manufactures are produced. And yet, strange as it may seem, this chosen center of Canadian industry is woefully devoid of native fuel suited to the generation of abundant power and the heating of the habitations of the millions of people making their homes in that region. In Quebec there is neither coal nor mineral oil for power purposes; and Ontario can boast only small and diminishing quantities of natural gas and petroleum. True, in the northern part of the province, traces of low-grade lignite have been found, but so far nothing has been disclosed that warrants the belief that there are any deposits of coal of actual commercial value.

While nature has been seemingly stingy on one hand she has been generous on the other in furnishing a substitute source of motive energy. Canada, in its entirety, has a total endowment of approximately 20,000,000 horsepower in her falling waters, and fortunately three-fifths of this aggregate of inexhaustible impulse flows through the Provinces of Ontario and Quebec—for the most part within easy reach of the present settled area. For a while, and that only a few years back, water-power developments were sporadic and wholly in the hands of private enterprises; and those that partook of a public-service character were, more often than otherwise, inclined to exploit the people—charging for current out of all proportion to the cost of generation and distribution.

During this period, the main reliance of the populace was upon coal for domestic heating, and the majority of industries also depended upon this fuel, most of which reached them from the United States. Then came the coal strike in Pennsylvania during the fall of 1902, and a Canadian Railway, tapping that source, showed no disposition to transport the coal already mined when the rigors of winter set in. Citizens in Toronto had to pay a hundred per cent more for their fuel; and their intense suffering was mitigated only by importing coal from Wales. That experience directed general attention to the fuel and power problem of Ontario and Quebec, and the taxpayers of Ontario were aroused to a better understanding of what water-power meant to them and how intimately they were concerned in the potential benefits of long-distance transmission of electric current.

Out of the agitation that followed, the Ontario Hydroelectric Power Commission was born in May, 1906, and modified for the better by the act of the succeeding year and by various subsequent amendments, the last of which was passed by the Canadian Parliament in 1920. The Commission is, in effect, a body corporate, consisting of three commissioners, two of whom may be members, and one of whom shall be a member, of the Provincial Cabinet. Broadly, the organization is a governmental one which is authorized to coöperate with municipalities and districts desiring electrical energy, and is empowered to build and to operate distributing systems, power plants, and even railways.

At the beginning, the Niagara Division of the Commission's project constituted the biggest hydroelectric distributing system then extant. Since then eleven other districts have been covered; and it is claimed that the present network of wires and the associated power plants form the greatest combination of its kind. It is certain that the undertaking has forged ahead in an impressive manner. In 1910, the Commission initiated its transmission business with the delivery of only 750 horsepower, and none of that energy was produced by it. Last year the transmitting wires distributed more than 315,000 horsepower, and by the close of 1921, when stations now building are ready, the total output for public use will amount to 750,000 horsepower—a thousandfold amplification of service in eleven years. By 1923 the aggregate production is expected to reach 1,400,000 horsepower.

The twelve active systems of distribution take care of 180 communities, ranging from cities down to villages and townships. In addition to these there are numerous municipalities that have made contracts with the Commission, and service will begin as soon as the necessary equipment can be obtained. And then there is a considerable group on the waiting list, which cannot be accommodated until the supply of current is equal to the demand. In brief, according to the reports, the actual and prospective centers of population interested in the Commission's work total more than 250.

Broadly speaking, the whole scheme is in a measure municipal ownership under Government control, with certain variations that give the Commission the right of initiative, the power of eminent domain, and authority to go ahead when the public welfare warrants. In general, when a city, town, village, or rural district wishes to participate in the benefits of the hydroelectric system, the community asks the Commission for information as to cost of local distributing lines and the needful connection with the nearest of the Government wires. The Commission's engineers examine the territory and report, and, if the terms suit the applicant, the taxpayers of the locality vote to provide the required funds. With this done, the Commission enters into a contract with the municipality. As a matter of security, the Commission then stands back of the community's obligation, and, in its turn, the province becomes the financial sponsor for the Commission. However, there is no revenue to the province other than the rentals it derives from leases of water-powers, such as those of the Niagara River, etc.

Even so, the province faces no liability in the working out of the undertaking, for the power and light users are charged sufficient not only to cover the expense of the service but to create a sinking fund which, in thirty or forty years, according to the arrangement, will leave each constituent community the owner of its plant. At the end of that time, the rates will be just high enough to take care of upkeep, repairs, and the actual cost of the electrical energy delivered. That is to say, the principle on which the Commission executes its trust is that the charges to the public shall be reduced whenever the income exceeds the surplusses required to meet the provisions of the sinking fund.

Generally stated, a steam-raised horsepower entails an outlay in Canada today from $40 to $60 annually within the territory where the Commission is able to give on an average a hydroelectric horsepower for only $18 a twelvemonth. This, so it seems, is less than half that charged in any section of the United States east of the Pacific slope. No wonder, then, that the Province of Ontario generates nearly 96 per cent of its power through the impulse of falling waters; and the Dominion at present has 276 developed horsepower for each thousand of its inhabitants—a ratio that is surpassed by only one other country, Norway. The Commission, through its widened use of electricity, has cut down the consumption of bituminous coal yearly in the Province of Ontario by something like 6,000,000 tons.

Electric power has been made available to well-nigh

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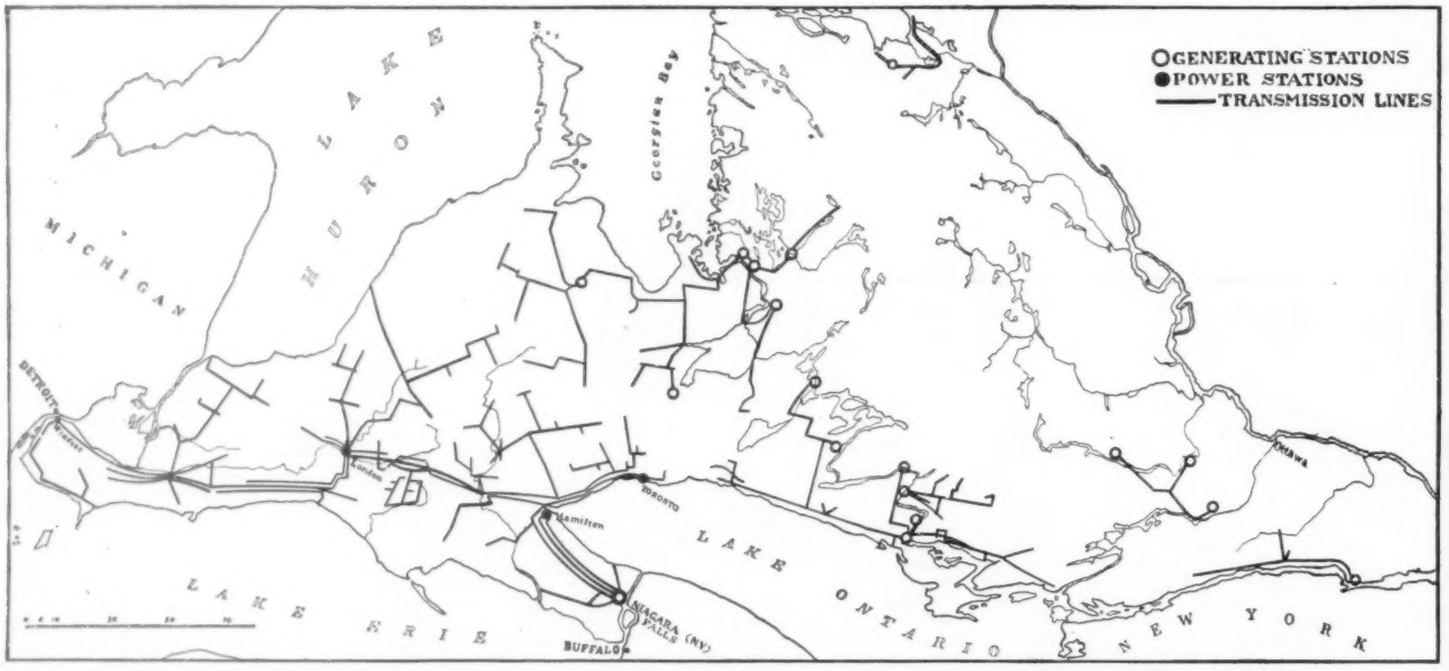


Map showing generating and distributing stations together with the transmission lines of the Ontario Hydroelectric Power Commission

Relativity and a Rotating Disk

An Application of Einstein's Theory that Has Caused Much Misunderstanding

By Leigh Page, Ph.D.

THE application of Einstein's principle of relativity to a rotating disk has proved puzzling to many readers. Therefore a close analysis of this problem may be of value in dispelling some apparent inconsistencies of the theory.

First it must be emphasized that the relativity idea does not hold true of rotation in the same sense that it does of translation. If two observers located in unaccelerated reference systems, such that one has a constant velocity of translation relative to the other, investigate the phenomena of nature—each relative to his own reference frame—they will arrive at identically the same laws. They will find no experimental means by which they can determine which observer is at rest and which in motion. In fact they will conclude that there is no meaning to the term "absolute motion," or "absolute velocity"; the only velocity which has any significance is that of the one observer relative to the other.

In the case of rotation, however, the matter is quite different. Consider two horizontal circular disks one above the other, one of which is rotating relative to the other around the common axis through their centers. If an observer on one disk finds that his geometry is Euclidean and that he can synchronize clocks in an unambiguous manner (his disk is not in rotation), the other will find—provided he can make sufficiently accurate measurements—that his geometry is non-Euclidean, and that if he synchronizes two clocks on opposite sides of his disk by a light signal guided by mirrors so as to travel along the periphery of the disk on one side of the axis, the result will be different from what would be obtained if the light signal followed a path on the other side of the axis. By such purely kinematical experiments the second observer can detect his rotation. In addition he could employ dynamical methods. He would find—provided he was standing at some point on the disk other than its center—that a body held in his hand would exert a pull on him in a direction away from the axis, which would be greater the farther away he moved from the center of the disk. If he was unaware of his rotation he might attribute this force to a gravitational field, but a type of field which obeys a law differing from Newton's law of gravitation in two important respects: First, the gravitational force is directed *away* from the center, and second, the force *increases* with the distance from this center. Einstein's equivalence hypothesis asserts that the observer on this disk could not tell in any way whether he is located on a rotating disk or at rest in a gravitational field of the type described. Therefore space in such a gravitational field must be non-Euclidean in the same degree as on the equivalent rotating disk. This illustration of the meaning of the equivalence hypothesis is made use of by Einstein himself (Relativity—Translation by R. W. Lawson, Henry Holt & Co., 1920, Chap. 23), and has been repeated by Mr. Bolton in his prize winning essay. It is the non-Euclidean character of space on a rotating disk which has proved a stumbling block to some readers of Einstein's theory, and which it is proposed to examine in detail.

Suppose that a number of short measuring rods identically alike are divided between the observer A on the rotating disk and an observer B who does not partake of the rotation. B places a row of measuring rods end to end under the disk along a line extending from the center out to the edge, and a ring of rods all the way around the periphery of the disk. As his rods are stationary, he will find that the number of rods on the circumference of the circle he has constructed is just 2π times the number on the radius. Now let A do the same, placing his rods *on* the disk. Each rod A has laid along the radius will appear to B to have the same length as his own, but the special theory of relativity teaches us that the rods laid along the circumference—since they are moving in the direction of their length—will appear to B to be shorter than his stationary rods. Therefore if B makes a count at any instant of the rods laid by A on the disk, he will find the number around the periphery to be *greater* than 2π times the number along the radius. As we are dealing here with a count of discrete objects, A will get the same results as B. Hence A's space, if measurements are made in the way we have described, is non-Euclidean.

Suppose, though, that A places his rods on the disk while the disk is at rest relative to B. Then, of course, A will find that he has placed 2π times as many rods around the circumference as along the radius. If now, the disk is set into rotation, carrying with it the rods placed on it, what is going to happen? Unless the relativity theory leads to a contradiction, one of three things (or a combination of them) must take place. First, the rods along the radius may remain end to end in a straight line, and small gaps appear between adjacent rods along the circumference so that if the latter are pushed together additional rods will be required to complete the circuit; second, the rods along the circumference may remain end to end and it may be necessary to remove some of the rods along the radius to prevent buckling; or third, all the rods may remain end to end but the initially straight row along the radius may become curved as a result of the rotation so as to resemble one of the spokes sometimes seen on fly wheels. In the first case B would conclude that the radius of the disk had been unaffected by setting it into rotation, whereas in the other two cases the disk would appear to him to have shrunk. Which of these effects would actually occur could not be predicted without a much greater knowledge of the structure of matter than we have at present, and to settle the matter by experiment appears hopeless on account of the smallness of the effect for velocities of rotation low enough to avoid disruption of the disk. Of course, centrifugal strains due to rapid rotation are supposed

(*Continued on page 259*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Mining Coal in Germany

To the Editor of the SCIENTIFIC AMERICAN:

Assuming that you desire the greatest amount of accuracy in your publication, I call your attention to page 635 of the issue of December 25, 1920.

There is an illustration of the Lubecker type of excavating machine which is stated to be "Scraping off the coal in the open mines."

The writer is very familiar with this type of machine and calls attention to the fact that the machine as shown is stripping the overburden from the coal deposit after which the coal itself, in a comparatively thin vein, is mined out.

You will realize of course that the description given in connection with the picture would assume a coal vein thirty feet in thickness, starting at the ground level.

GEO. B. MASSEY.

Chicago, Ill.

Wireless Range and Magnetic Storms

To the Editor of the SCIENTIFIC AMERICAN:

In the *Radio News* for December, 1920, is an account of the receipt in Scotland by a wireless amateur, Mr. George W. Benzie, of wirelessly transmitted speech from the station of Mr. Hugh Robinson at Keyport, New Jersey, 200 watts being used, and Mr. Gernsback suggests in an editorial that "all such freak messages take place only during magnetic disturbances of the earth."

This suggestion is of interest because I had already pointed out in my paper on wireless telephony, "Transactions of American Institute of Electrical Engineers," July, 1908, that super-positions of curves of magnetic disturbances furnished me by the U. S. Weather Bureau with the curves taken by me of relative intensity of transatlantic transmission showed that the curves had the same character and that therefore the two phenomena were related to each other.

Two and a half years ago I published in the SCIENTIFIC AMERICAN an account of the first transmission of speech across the Atlantic on several occasions in the spring of 1908 between Brant Rock, Mass., and Macrihanish, Scotland.

It would be very interesting if some one in a position to obtain access to the records of magnetic storms would ascertain if there were not strong magnetic storms in the spring of 1908 about the time this first telephonic transmissions took place.

Of course, the transmissions referred to, since they were carried out with professional apparatus and towers 420 feet high and one kilowatt of energy at 17,000 cycles, are not by any means comparable as a feat with the receipt by Mr. Benzie from Mr. Robinson's station but it would nevertheless be a matter of scientific interest to know if the transmission on the two dates referred to occurred during magnetic storms as, if so, it would tend to confirm Mr. Gernsback's theory and the relation of the curves for transatlantic transmission and magnetic disturbances referred to in my 1908 paper.

REGINALD W. FESSENDEN.

Boston, Mass.

Steam Airplane?

To the Editor of the SCIENTIFIC AMERICAN:

I note a recently published statement that eighteen aviators have lost their lives in the United States aerial mail service since May 15, 1918, and as many of these accidents were doubtless due to engine failure I write to suggest that there appears to be every reason to believe that steam engines could be successfully used on flying machines instead of internal-combustion engines, and thus one great cause of accidents removed. In an account of Sir Hiram S. Maxim's experiments with airplanes in 1892 I find the following: "He built a pair of compound engines, with cylinders of high-grade cast steel, which, together, weighed 640 pounds and, with a steam pressure of 320 pounds to the square inch, developed 362 horsepower, or one horsepower for every 1.76 pounds of weight. Steam was supplied by a special water-tube, oil-fired boiler, which weighed about 1,000 pounds," and besides there was "600 pounds of water in the tank and boiler." This makes a total weight of 2,240 pounds for the engine, boiler and water (fuel weight not being stated), or less than 6.12 pounds per horsepower, as compared with a weight of 8 or 9 pounds per horsepower for the Wright brothers' engine of 1909, and surely much greater efficiency in the matter of weight per horsepower can be secured by making use of the modern improvements in light-weight steam engines as exemplified in the Doble and other steam automobiles. As the advertisements say—"eventually, why not now" use steam engines on flying machines? Then, with the advent of the helicopter (which seems quite near), with its ability to land safely anywhere, and its safe controls consisting of propellers instead of inert plane surfaces, aviation will be safe.

Livermore, Cal. ELMER G. STILL.

The Big Navy

To the Editor of the SCIENTIFIC AMERICAN:

Kindly allow a word of appreciation of your articles in your issues of January 8 and January 22 on the question of disarmament. I have admired your paper for many years and I am convinced that today you are rendering to humanity a great service because of the position which you take in this matter.

Ft. Wayne, Ind. JAMES STRACHAN.

"His Hair Turned White Overnight"

To the Editor of the SCIENTIFIC AMERICAN:

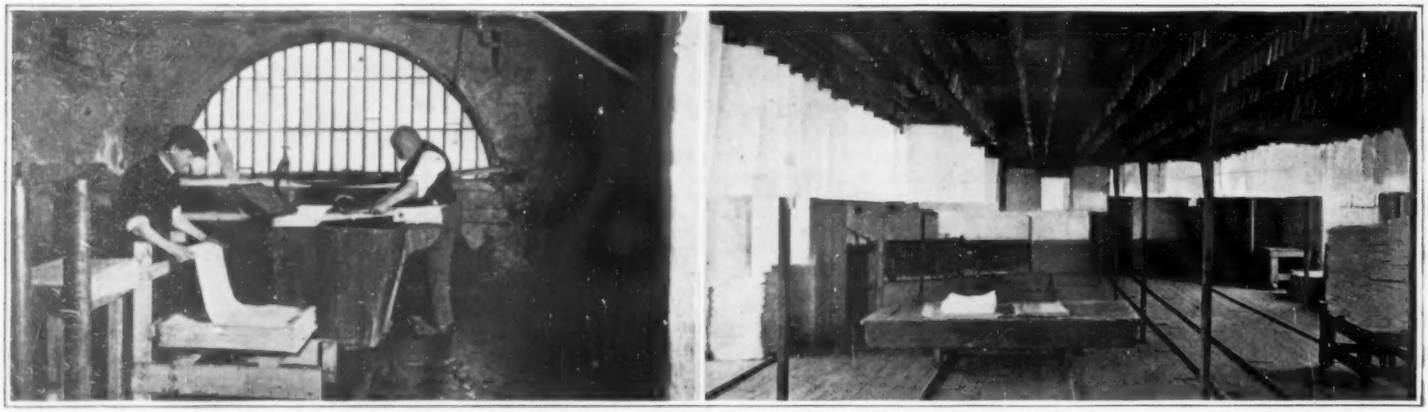
All my life I have heard persistent but not very well authenticated reports of cases in which a man's or woman's "hair has turned white in a single night." The cause to which it is attributed is usually fright or worry. I have never had opportunity to investigate one of these reports nor sufficient credulity to accept it without proper verification, and I should like to see a discussion of the matter in your columns.

To me it seems that when a portion of a hair is well outside the skin it is from there outward technically as dead as if it were cut off and sealed up within a locket, for it no longer has either nervous or nutritional connection with the body except for a little external oiling.

A man's natural hair turning white in a night would surprise me as much as if his wig lying on the dresser underwent a like chromatic transformation between suns.

Perhaps the early (and later, also) reports of sudden grayness originated in cases of the removal "in a single night," of hair-dyes when people far past middle age were ready to give up (without revealing their secret deception) the hopeless struggle of trying to keep up a youthful appearance.

Forsyth, Georgia. WADE HAMPTON STEMPLE.



Left: The man standing at the vat dips the mold into the fibrous pulp and forms a sheet of paper. His assistant turns the newly formed sheets upon pads of felt. After a sufficient pile has been formed of alternate layers of paper and felt, the mass is subjected to great pressure to force out the superfluous water. *Right:* Drying loft of hand-paper mill, where the sheets are allowed to dry out naturally after the preliminary pressing

The manufacture of hand-made paper as practiced today

Watermarking Hand-Made Papers

Some of the Details of This Obscure Art, as Practiced in Ancient and Modern Times

By Dard Hunter

BEFORE the invention of the paper-making machine in the early nineteenth century all paper was made by hand. In making fine papers for letter-press printing, etching and engraving and for paper in which an artistic or elaborate watermark is desired the hand-made process is still used.

The modern method of making sheets of paper by hand differs very little from the process employed in the fourteenth century. The sheets are molded in a rectangular frame over which is stretched a wire covering, like a sieve. Around the top edges of this mold a movable mahogany frame is fitted which determines the size of the sheet to be made but has nothing to do with the thickness of the paper. After the wet fibers have been deposited on the mold the wooden frame or "deckle" comes away so the sheet can be laid or "couched" on a piece of felting.

The wire covering of the mold may be of two kinds, either "laid" or "wove." The laid mold covering has been in use since the beginning of paper-making, but the wove is of comparatively recent date, having been originated by John Baskerville, the reviver of printing in England, in 1750. The oldest mold covering was made of strips of bamboo and bound together by filaments of vegetable fiber. It is not known when metal wire was first used but it no doubt became a material for covering molds several hundred years before the introduction of paper-making into England in 1494.

A watermark is caused by wires in the form of objects or designs sewed to the laid or wove covering of the mold. In a laid sheet of paper the laid and chain lines may be seen when the sheet is held to the light and any wire work that is applied to the top of these wires may also be seen. On the mold the wet pulp lies flat on its top surface but underneath where it lies against the wires of the watermark the pulp is naturally held thinner. It is this thin part in contrast with the balance of the sheet that gives the transparency of a watermark. These wire marks in the form of designs are held in place on the surface of the mold by means of wire stitched back and forth over the mark. In some of the old watermarks it is quite possible to detect the impression of these sewing wires in the paper where they held the pulp thinner at these points.

As long as molds have been used for making paper, watermarking has always been accomplished, as the laid lines formed by the bamboo sticks or metal wires of a mold caused the pulp to lie in different thicknesses, thus causing a watermark unintentionally. A watermark in the form of a design or symbol has never been discovered in any of the early papers that were made on a bamboo or vegetable fiber mold. The earliest mark in the form of a design or object made its appearance about the year 1301 and was made in wire. A great many of the fourteenth century papermarks were composed of circles and crosses in simple forms and were mostly of Italian origin. These marks were made of heavy wire which would not admit of much intricate twisting or forming into artistic or complicated shapes. During the fifteenth century the wires for both marks and sewing gradually became finer and the designs were much more detailed and elaborate in character.

All of the paper used in England until 1494 when the Tate mill was started, came from the Lowlands and while the material used was good the workmanship was not the best. Caxton, England's first printer, in order to get sheets of an even thickness and color had to sort over paper of many different makers and dates. This would account for the presence of so many different watermarks in books printed in the fifteenth century. It is not uncommon to find as many as eighteen or twenty different papermarks in a single volume.

Three or four hundred years ago the average workman could not read and it was necessary to appeal to him by means of pictures and symbols. It is thought the watermarks were likely used to designate one sized paper from another and to give it a name. To simply mark a mold with figures or letters would have meant little to the artisan of the fifteenth century so emblems were used and such marks as foolscap, hand, post, crown and pot were primarily used as marks of identification to distinguish one sized mold or sheet of paper from another.

During the fifteenth and sixteenth centuries after lighter wires came into use we find the designs becoming more complicated and different kinds of animals were pictured in abundance. These watermarks were probably used to designate the sizes and kinds of paper as well as trade-marks and symbols of the makers. The cock, a French mark of 1402, exhibits a deal of motion and life as does the drake of 1411. The dog from the year 1479 is indeed full of vigor; not one of these few examples could have been made by an unskilled draughtsman. The human figure was not much used as a watermark.

The oval is made in a different color from the margin of the sheet by stenciling out each in turn; the two portions of the sheet are united while still in the wet pulp state

Wove mold for making sheets of paper in two colors

Modern watermarking of laid hand-made paper is accomplished in precisely the same manner as it was in the fourteenth century but, as in all lines of endeavor, many minor improvements have been made. The wires used in modern times for forming the designs are usually of brass, silver plated, and are made in twelve diameters, measuring between 18/1000 to 32/1000 of an inch. The sewing wires used in binding the marks to the molds are about 5/1000 of an inch in thickness. Such sewing wire is too fine to leave an impression in the sheet of paper. The simplest form of watermarking is accomplished by the use of these wires twisted in the form of lettering, crests, trade-marks or any emblem where an outline design can be used.

The shaded watermarks which are made in the woven wire covering are the most artistic and will admit of the most complicated form of design. The woven wire is made in very much the same manner as woven cloth and with its invention new possibilities in watermarking were opened up but were not developed extensively until the middle of the nineteenth century. The weaving of these wires for mold covering is done both by hand and machine on special looms; the wires first being passed through diamond dies to insure smoothness and uniformity.

The method of making shaded watermarks was originated about seventy-five years ago by Mr. W. H. Smith an English paper-maker. The process consists of making an electrotype of a model or bas-relief of the object to be reproduced in the watermark and backing it up with lead or gutta percha to hold it firm. The woven wire or gauze is then pressed into the mold or matrix and the impression in the wire is mounted as a covering on the wooden frame of the mold and used for making paper in the same manner as a laid mold. It is difficult to form a shaded mark on a wove mold in the wet fibrous pulp. It requires a special treatment of the rag pulp to give a clear, sharp watermark in the sheet. This method of watermarking paper is used in making portraits and all objects where an exact reproduction is desired, as it is possible to give any degree of lightness or density. The deepest impressions in the wire covering of the mold cause the pulp to lie the heaviest and the highest parts of the mold give the thinnest part in the sheet of paper. In a light-and-shade papermark the heaviest part of the design of picture will be about three times as thick as the margin or outside of the sheet while the thinnest part or highlight of the picture will be little more than a very thin film of fibers.

Watermarked note papers of this variety are used

(*Continued on page 259*)

A New Type of Displacement Speed Boat

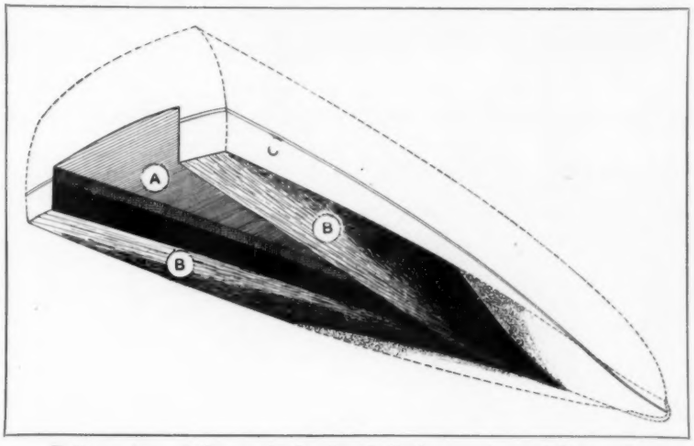
AT the recent Motor Boat Show in the Grand Central Palace, a new displacement type of motor boat named "Tarpon" created quite an interest, because it had shown high speed efficiency, and qualities of seaworthiness most unusual in a speed type of boat.

In general appearance it looks like the concave "V" bottom runabouts so familiar to yachtsmen. The secret to the invention appears in the construction of the after portion of the bottom. To illustrate this construction a sketch is shown of the boat. The wedge-shape area of the bottom as designated by "A" is 13 inches higher than the rest of the bottom. "B" represents the shaded areas around the wedge-shape opening. "C" is the normal load water line at rest. When the boat is driven at speed, the concave "V" shape of the forward portion of the boat causes the boat to lift, and a considerable area that was wetted at rest is not in contact with the water at speed, and this decrease in frictional area permits any given power to drive a boat at higher speeds. This action is the same as that of the standard concave "V" bottom models. But this improvement now discloses advantages over the standard "V" bottom models, because in the area "A" some 30 sq. ft. of frictional surface is also eliminated and the result is an increase in speed efficiency of 10 per cent. At full speed the boat rides (or planes) on shaded areas "B" and the relative intensities of the shaded areas represent the relative capacity of each portion of the bottom to carry weight. This shows by heavy shading that the primary contact between the dense water and the planing surface is the most effective lifting area on the bottom. Forward of heavy shaded area the fuzzy area shown on the drawing denotes frothy, disturbed water preceding the dense contact of the water and planing area: this broken water has no lifting value.

It will be noted that after primary contact, the areas farther aft are progressively less effective as lifting or planing areas and are so denoted by lighter shading. Moreover, it will be noted that the chine areas (outside edges) of the planing areas show efficiency farther aft than the area toward the middle. This is due to the fact that in the middle areas the distance to primary contact is greater, and the fact that the concave "V" shape of bottom tends to crowd the water toward the chines quite densely. This brings us to another feature of the invention. It was found that a standard concave "V" bottom created a vacuum in the area eliminated in this new invention as shown in area "A" and caused undue settling of the stern and undue elevation of the bow. In the "Tarpon" the stern rides on the surface of the dense water and throws only a feather of thin spray off the sides as shown in the photo. Moreover the "Tarpon" takes advantage of the improvement by adding several inches to the bow freeboard thereby making it better for rough water at low speed. A standard speed runabout could not stand the added freeboard, because the bow would rise so high at speed that the driver could not see over it.

The last outstanding feature of this boat is seaworthiness, which has always been a sore point with speed-boat models. If speed were eliminated from consideration, the best model for seaworthiness would be a double ender like a life boat, because it would have its greatest displacement midship, and practically no displacement at the ends. The "Tarpon" has its greatest displacement midship, has a pointed bow and its displacement at the swallow-tail stern is very little.—By *L. L. Tripp.*

The newly-developed displacement boat running at full speed, showing how it rides with a minimum contact with the water



Bottom view of the newly-developed displacement speed boat. At full speed the concave "V" shape of the forward portion causes the boat to lift

A moment after the engineer has applied the air pressure the logs are unloaded from the cars. The compressed air releases the pins which hold the side stakes in place

Track and cableway employed in operating motor trucks between the quarry and the shipping point. The track consists of two trough-shaped, steel runways, spiked down to wooden ties

New Uses for Old Battleships

THE United States Navy, instead of ruthlessly scrapping its old battleships by selling them to the junk man, is finding new service for them in the Navy. It is proposed to turn some of the older ships into tank barges of large capacity. To this end, the turrets, guns, armor and interior bulkheads will be removed until nothing but the shell of the ship is left. The interior will then be rebuilt to render the ships serviceable as oil tankers. One of the battleships, the "Kearsarge," famous in her day as having been, with her sister ship, the "Kentucky," the first to mount the double-deck turret, is being transformed into a floating crane, and our colored cover shows this craft as she will appear when the metamorphosis has been completed. The superstructure of the ship, in the way of rotating crane, engine house, et cetera, is shown in our illustration. The hull of the ship has been reconstructed with a view to giving it increased lateral stability, so that it may be able to withstand the overturning movement when the crane is lifting heavy loads at its full reach. The advantage of the floating crane is that a ship can have her guns and other heavy parts removed without having to go into dry dock or even alongside the wharf. The "Kearsarge" will be big enough to carry a heavy load of guns and armor plate wherever she may happen to be, and transfer her loads while she is moored alongside a ship.

Heat Insulators

THE Bureau of Standards has made a somewhat extended investigation of heat insulating properties of materials used in fire-resistive construction. Cylindrical specimens were heated in a suitable furnace, temperatures at different depths in the specimen being measured during the test.

Technologic paper No. 130, of the Bureau of Standards, embodying the result, is now ready for distribution and those interested may obtain a copy by addressing a request to the Bureau.

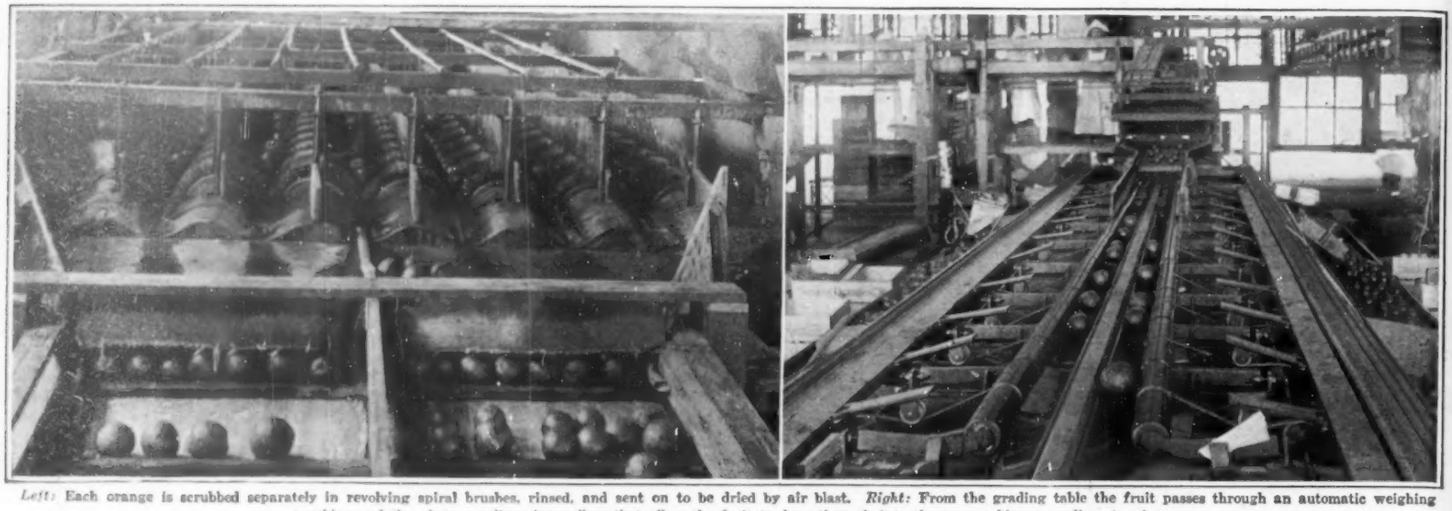
Unloading Logs with Compressed Air

A SPECIAL device that is proving of great service in logging operations makes it possible to unload eighteen cars of logs at a pond in six to eight minutes. When the train is properly spotted at the pond the man in charge of unloading adjusts the lock pins and then gives the engineer the signal to apply the air. The engineer makes a 20-pound application, which operates the device, releasing the stakes on the side next to the pond and allowing the logs to roll freely. The outside rail of the pond track is elevated 15 inches above the inside rail.

The stakes are then put back in place, the lock pin replaced, and the car is then ready to load. One company in Arizona that uses this device now operates with just one-half the rolling stock formerly used. The time at the pond is cut very materially. One man can handle the unloading at the pond.

Tracks and Cables for the Motor Truck

AN automobile track, probably the first of its kind, is in constant use in the granite quarries of Quincy, Mass. The unique track is built on the site of one of the first railroads in the United States. It is employed to take out blocks of granite from the quarries to the shipping point, and permits heavily laden motor trucks to negotiate the steep grade without danger of any sort, even in severe winter weather. The motor trucks operate over the trough-like steel tracks without a change in the usual wheel and tire equipment, a cable being used because of the steep grades.



Left: Each orange is scrubbed separately in revolving spiral brushes, rinsed, and sent on to be dried by air blast. *Right:* From the grading table the fruit passes through an automatic weighing machine and then between diverging rollers that allow the fruit to drop through into the proper bin, according to size

Grooming and grading oranges for the market by the latest machine processes

Putting Rejected Oranges to Work

How California Fruit Growers Are Utilizing Their Citrus By-Products

By Arthur L. Dahl

IN the growing and marketing of any kind of fruit the great problem is to cut down the percentage of loss through the discarding of fruit not quite up to standard in appearance and size, even though the quality might be just as good as the accepted kind.

The citrus fruit of California, though not of the extremely perishable kind, must nevertheless be boxed and shipped in perfect condition to withstand the exigencies of a long journey across the continent and numerous handlings by jobbers and dealers before it reaches the consumer. As most of the oranges sold in the East by the California growers are marketed on a quality basis, with strict standards as to size and appearance, it is inevitable that a large percentage of the oranges and lemons grown are discarded from shipment to the trade by reason of blemishes, misshapes, size and other causes. Such oranges and lemons are called "culls" and in the past they were virtually a dead loss to the growers, as the local markets were usually glutted and no other means were at hand for utilizing them. In a year of normal crop there are approximately 28,000,000 pounds of cull oranges, and in finding uses for this discarded fruit the California Fruit Growers Exchange serves not only its members but the public at large, for it turns an economic waste into worth.

The citrus growers of California have formed one of the most efficient and successful coöperative marketing organizations in the world, and one of the results of that coöperation is the development of a means for utilizing a large proportion of this cull fruit. The task of experimenting in the utilization of this waste was too heavy to be assumed by individual growers, but with an organization made up of several thousand orange and lemon growers it was possible to employ food chemists and erect experimental laboratories to develop uses for citrus by-products, and this, in effect, is what the marketing association did, through its subsidiary, the Exchange Orange Products Company. The Department of Agriculture aided in the work by establishing a branch of the Bureau of Chemistry at Los Angeles, and within the last few years more than $100,000 has been spent in experimental work.

While the by-products industry is still young, there are now more than 20 factories for the manufacture of marmalade and jellies from orange pulp, and considerable business is done on dried orange peel, orange vinegar and other food products. Similarly, several plants are engaged in the manufacture of citric acid and other chemicals and oils from cull lemons and oranges, and new uses are being found, from time to time, for the residue. The refuse from the citrus cull plants is even saved and used for fertilizer.

In the utilization of cull oranges, the Exchange is working along the line of converting the fresh pulp into marmalade, while the skins are used for the extraction of orange oil, for which there is a considerable demand.

The fresh cull oranges, after being sorted to take out all of the rotten and undesirable fruit, are run into an automatic slicing machine, where the fruit is cut up into small pieces, so that all of the valuable properties of the fruit may be easily got into suspension in the first cooking process.

From the slicing machine the fruit is dropped in large steam jacketed kettles, where sufficient water is added to keep the fruit from burning, and the whole mass is boiled into a heavy pulp. After a given time, this pulp is run through a continuous press, where all of the acids, fruit sugar, and other valuable properties of the fruit are pressed out and collected in a large tank, where the temperature is kept uniform and the juice standardized for all of its valuable properties.

From this tank the juice is pumped through a large filter, which has a capacity of over 200 gallons an hour, and in this filter all of the flocculent matter that is carried through the press by the juice is removed, and the resultant product is the essence of the fruit—clear, sparkling, of uniform chemical composition, and without any of the fibrous substance so common in orange products and with little or no food value.

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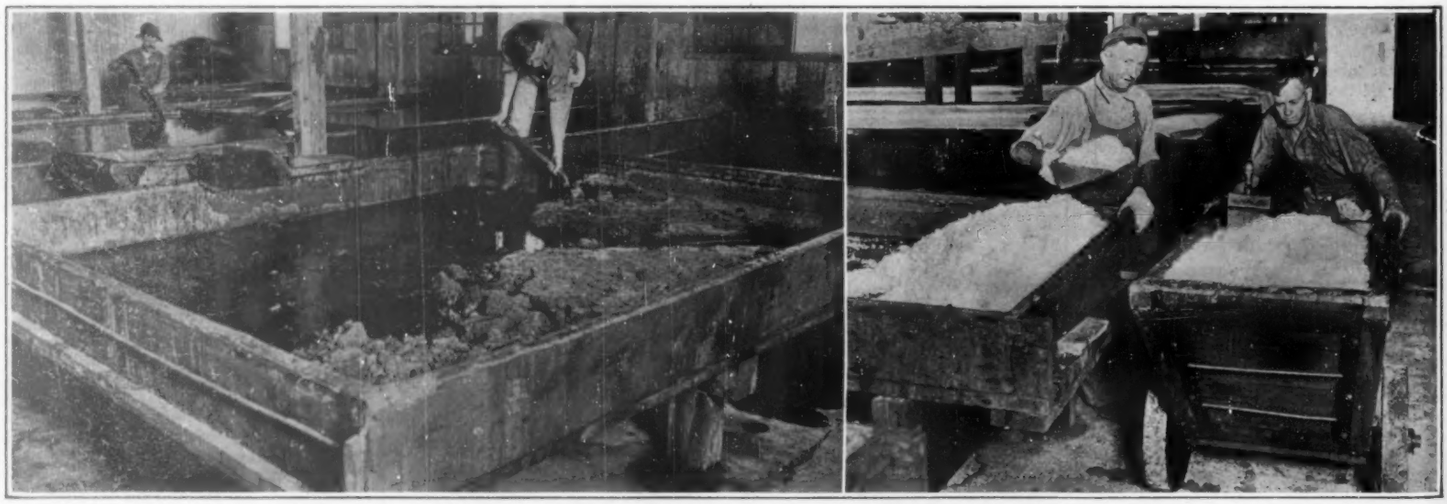


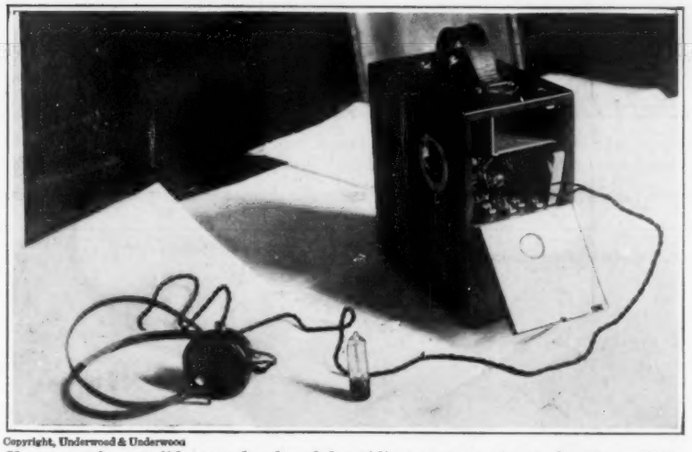
Left: After boiling in the vacuum tanks, the strong citric acid liquor is pumped into the first crystalizing pans, where, after cooling, it forms a thick black mass. *Right:* This mass is redissolved, impurities taken out, and a second boiling effected under vacuum. At the point of crystalizing, the liquid is pumped into another shallow pan to cool. This picture shows the resulting white crystals ready to be washed and finally purified for packing

Making fruit extracts out of the part of the crop that cannot be sufficiently groomed for sale raw

Using the Vacuum Tube So That the Deaf May Hear

THE problem of developing an electrical instrument that will be an aid to the partially deaf, as glasses aid those whose vision is defective, has engaged the attention of some of the world's greatest scientists and physicians.

Considerable progress has been made in the development of telephonic hearing aids for the deaf, but due to the inherent limitations of the telephone transmitter and receiver, development along this line had apparently reached its limit when what is nowadays known as the "vacuum tube amplifier" opened a new field for research and development. Due to the fact that it is a distortionless amplifier of minute electrical impulses it is adaptable for use in an electric circuit between the telephone transmitter and receiver. In other words, it conveys and reproduces human speech more clearly and loudly than any electrical hearing aid so far produced.



Copyright, Underwood & Underwood

Vacuum-tube amplifier set developed for aiding persons of poor hearing. Note the diminutive vacuum tube near the pair of telephone receivers

It has remained for Earl C. Hanson of Washington, D. C., to apply the vacuum tube amplifier as a hearing aid for the deaf. The result of his extensive work with vacuum tube amplifiers is represented in the highly compact set shown in the accompanying illustration, which is intended for the use of persons more or less deaf. This set may be used anywhere, being quite portable and entirely self-contained.

One of the great difficulties encountered heretofore has been that in the effort to obtain volume, the transmitter has been overloaded, causing a roaring or undertone in the receiver. Telephone engineers and those familiar with the characteristics of the vacuum tube agree that it amplifies feeble currents without distortion. This permits the use of a telephone transmitter without overloading and thereby retains the clear speech received over line wire telephony. Persons with normal hearing, and even those who hear poorly, hear distinctly on the standard wire telephone. Many persons afflicted with deafness use the telephone satisfactorily, even though they have difficulty in distinguishing ordinary conversation. The reason for this is that the telephone apparatus concentrates the sound in the ear.

Mr. Hanson's device consists of a more or less in-

(*Continued on page 260*)

Making Barrels Out of Paper

IT appears as though the barrel problem, which is an important one in many industries, has been solved at last. A highly ingenious machine which may be installed in any plant and operated by anyone, makes it possible for an organization to make its own barrels out of paper. The paper is bought in rolls, and the barrels are made as needed. Hence there is no waiting for the barrel man to deliver the barrels ordered; the machine is operated for twenty-four hours if need be or not at all, according to the immediate demand for barrels; the paper in the form of compact rolls takes up little space as compared to empty barrels; and the paper barrel is a lighter and tighter container.

The paper-barrel machine is the invention of George C. Snyder of New York City, although its development to the commercially practical stage has been brought about by others. As will be noted in the accompanying center view showing the machine, it consists of a two-part mandrel which is capable of being rotated by power and also of being more or less drawn apart, a paper feeding and coating mechanism, a slitter, and a collection of accessories for controlling the size and thickness of the barrel being turned out. To start the operation, the end of the roll of paper, which passes through tension rollers and over the coating mechanism which coats one side of it with the adhesive liquid, is drawn on to the mandrel and inserted in a slot. The mandrel is then rotated by power for a certain number of turns, after which a slitting wheel is brought into action for cutting the paper into two strips. Then the

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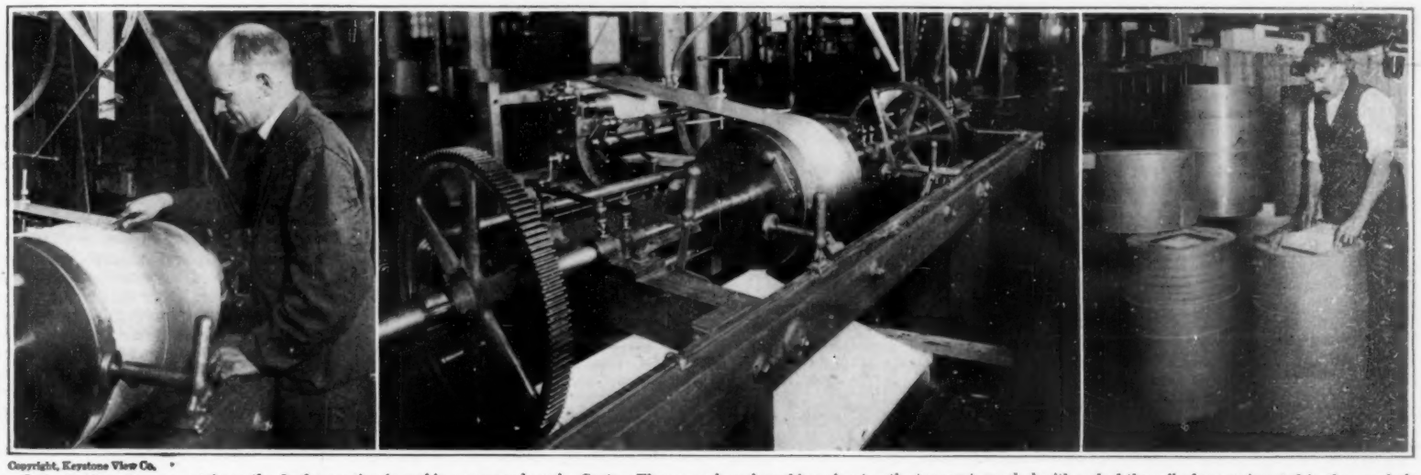


Copyright, Keystone View Co.

Left: Cutting the paper strip as the final operation in making a paper barrel. *Center:* The paper-barrel machine, showing the two-part mandrel with end of the roll of paper inserted in the mandrel slot, and the paper-feeding and coating mechanism at the rear. *Right:* Placing wooden ends on the paper barrels. The ends here shown have been discarded more recently in favor of either a more substantial wooden end, or, better still, a pressed steel end piece which fits on tightly and reinforces the barrel

How rolls of paper are converted into paper barrels as fast as they are required for shipping purposes

Combined Tire and Caterpillar Tank

ALMOST interesting demonstration was recently given at Hoboken, New Jersey, when new types of vehicles under construction for the Ordnance Department of the United States Army at the plant of the Front Drive Motor Company were maneuvered before officers of the Ordnance Department and other interested branches of the service. Gun mounts and a tank were run over a specially constructed obstacle having a slope of thirty-five degrees on one side and of forty-five degrees on the other. The vehicles climbed up and over this obstacle with ease.

Probably the most important feature of these new vehicles, which are being developed jointly by the officers of the Ordnance Department of the Army and Mr. Christy, is the remarkable method of progression. Ordinarily, when they are in motion, the machines perform like the usual caterpillar-tread vehicles; but when high speed is desired over good roads, the tracks are removed and the vehicle runs along on its wheels at

(*Continued on page 260*)

Officers of the U. S. Army Ordnance Department watching a demonstration of a new type caterpillar self-propelled mount for a 155 m.m. rifle at the plant of the Front Drive Motor Company, in Hoboken, N. J. The mount, designed by Mr. Walter Christy, has many new features and improvements over the type now in use

New caterpillar gun mount and small tank demonstrated for Army officers

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

What Poor Packing Really Means

WE have heard a good deal regarding poor packing, especially from our friends abroad to whom we have shipped goods in the past. It seems impossible that the stout cases which leave the American plant should arrive at their overseas destination badly battered and broken and even pilfered, yet such is often the case. The accompanying photographs, made at various South American ports, show the sad experience with more than one American shipment.

Fortunately, the American shipper has learned a good deal about packing in the past few years. There was a time when our packing was simply impossible and it did us no end of harm in curtailing the growth of our export trade. That was the time, too, when British and German firms took consummate care with their packing, resulting in the safe delivery of their merchandise in all parts of the world.

Today the successful American exporter has learned to pack his goods in the proper manner, and one is often surprised to find heavy merchandise, such as machinery, so well protected in heavy boxes and cratings that the packing appears to be overdone. The larger companies doing an extensive export business maintain elaborate carpenter shops for making cases and crates, and use lumber in what appears to be a lavish manner.

However all that may be, those firms have probably learned through bitter experience the necessity of packing as well as they know how, and making due allowance for no end of rough handling.

A crate of wire wheels as it was received at Callao, Peru, after shipment from the United States

Speeding Up the Handling of Ashes

HOW much does it cost you to handle ashes? Taking everything into account—labor costs, upkeep, depreciation, operating expenses, capacity—how do ash handling costs figure in your overhead? You keep a close watch on the cost of other operations entering into production. The same watchfulness should be applied to ash handling in your plant; for, as is too often the case, it may be one of the most expensive phases of your boiler house maintenance.

With a view to reducing ash handling costs to a minimum, there has recently been introduced a new method which is simplicity itself. It is known as the skip hoist system, and consists of a bucket running on an inclined or vertical track and hoisted by a steel cable winding machine, a hoist house and steel bunker. The ashes are collected from hoppers under the boiler by a small push or electric car. The ashes are dumped into the bucket. The pushing of a button sends the bucket up the track, dumps the ashes into a cylindrical steel bunker and returns the bucket for another load. The entire operation is automatic. A small sized skip hoist will easily handle eight tons of ashes an hour.

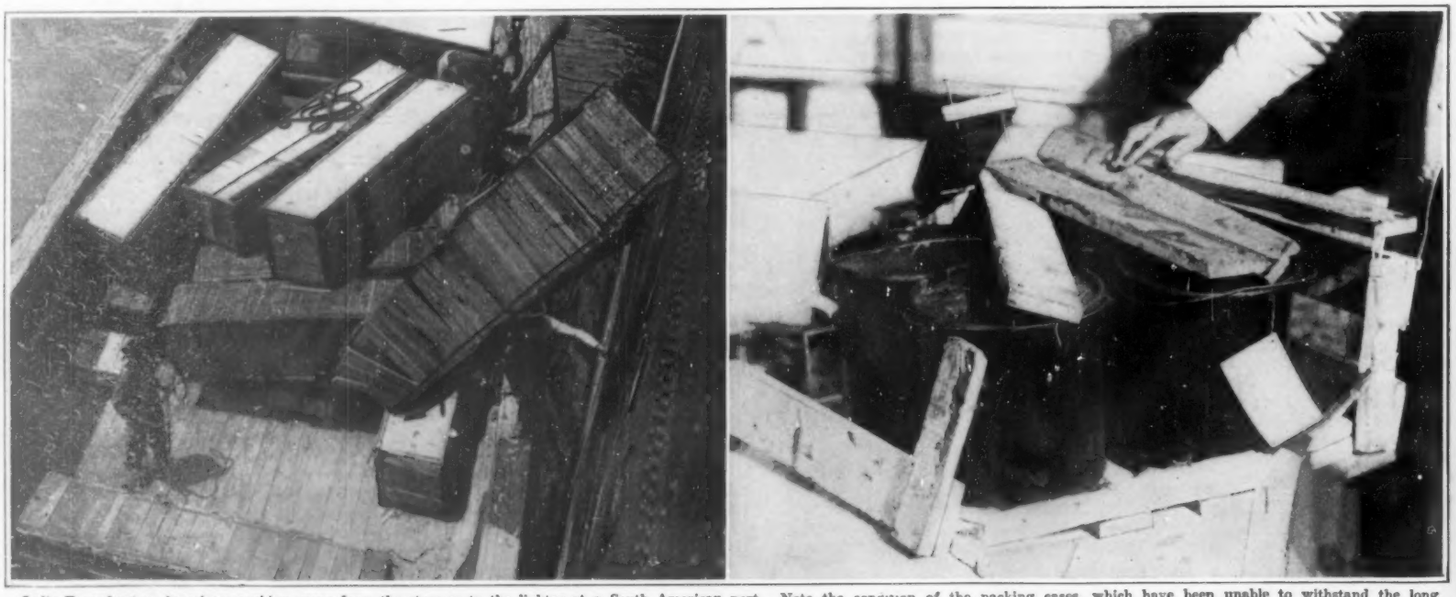
There are several features that recommend this system of ash disposal. The unskilled laborer operates the entire job. The skip hoist is a mechanical ash handling system that is unaffected by the destructive abrasive action of hot, dripping, wet ashes and grit. Repair bills are minimized. The consumption of minimum power means low operating cost. The elimination of complicated parts means less breakdowns and resulting repairs.

Turning Waste Paper Into an Asset

WASTE paper as such is worth little, and, furthermore, it is a menace about any plant. It should be baled and shipped direct to the mill in order to get it out of the way and realize its full value.

An indestructible, all-steel, hand-power baler has recently been introduced which serves the purpose of the average plant. It has a large open top, easy to fill, and may be readily operated by anyone. The litter and waste of the plant are placed in the machine and in a few minutes are converted into compact bales occupying but little space and representing a minimum fire risk. It may be used for baling paper, rags, wood or steel shavings, leather scraps, excelsior, cloth clippings and so on.

It is interesting to note that the paper barrels described elsewhere in this issue are made from chip board which in turn is made from waste paper, rope and other odds and ends. The conservation of such waste must result in cheaper chip board.



Left: Transferring American packing cases from the steamer to the lighter at a South American port. Note the condition of the packing cases, which have been unable to withstand the long journey. *Right:* What happened to a flimsy crate containing cans of paint. Is it any wonder that goods are stolen in transit?

What poor packing methods mean to the South American buyers of our goods

How Dobbin Pulls

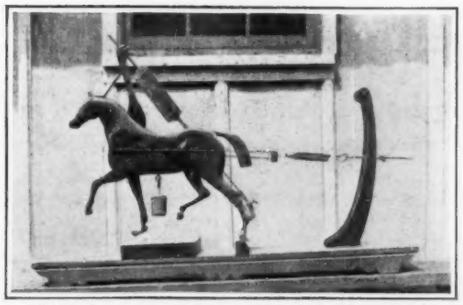
A SMALL horse stands in the laboratory of the Department of Agricultural Engineering at the University of Wisconsin, which was designed by the late Professor King in order to study the effect of the angle of trace, of the hock muscle, and of the distribution of the horse's weight upon the draft.

To determine the effect of the angle of trace, Professor King attached a steelyard scale to the traces and, back of an arc, a screw with which he could increase the pull on the traces. Then, setting the traces at a particular angle, the screw would be tightened until the fore feet of the horse were just raised from their base. In this position he was exerting his maximum draft. It was found that when the traces were below the horizontal the horse exerted more draft than when they were on the horizontal and that the draft decreased as the traces were raised; at an angle of twenty degrees the horse could exert twice as much draft as at zero degrees. The traces at an angle have two effects: one, of making it more difficult to raise the horse from his feet, and the other, of tending to lift the wheels of the vehicle over obstacles rather than dragging it over.

The hock muscle is probably of as much importance as the angle of trace. It is the straightening of this muscle which pulls the load forward, so that the stronger the muscle the greater the load moved. In the model the tension of the hock was about twice that of the draft and, while the same may not be true of a living horse, it serves to show how very strong the muscle must be to pull as it does.

Men may change the angle of trace, but they cannot change the hock muscle nor can they change the distribution of weight. The horse must be selected with regard to the last two for the distribution of weight is also of importance. The horse is a lever with a fulcrum at the hind feet and, properly placed, weight will greatly influence his ability to pull. Using movable weights Professor King found that when weight was placed at the center of the animal and the traces at the horizontal the horse could exert an additional draft equal to the weight added; but that if the traces were at an angle of twenty degrees the increase was double the weight. Other things being equal then, the heavier the horse the greater the draft. When the weight was placed at the forequarters the increase in draft was more apparent but when the weight was at the hind quarters the effect was less. This is what one would expect since the longer the lever arm the more effective the weight operating upon it. Therefore the desirable draft horse has heavy forequarters and not so much weight at the hind quarters, substituting there a strong hock muscle for weight.

The model horse is still working, for it is now being used by the students to determine for themselves the truth of Professor King's findings.



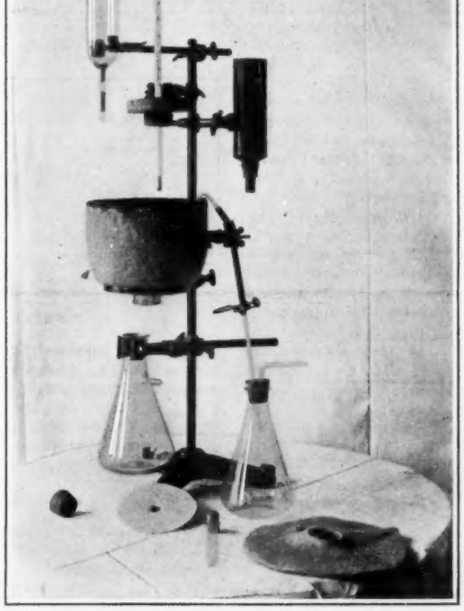
Model horse that demonstrates the best angle for the trace

Paraffin Percentages

ROAD-BUILDING materials should be evenly proportioned with respect to their various component parts; otherwise an excess of one ingredient to the sacrifice of another may determine ultimately the difference between a durable highway and one where the outgo for maintenance bulks big. For instance, the presence of paraffin, a white crystalline substance, in shale and other bituminous road materials suggests the necessity for the examination of products entering into the construction of highways. The determination of paraffin scale is made possible by an apparatus designed by the United States Bureau of Public Roads.

The novel feature about the apparatus is the administration of the water bath. The latter is arranged with a temperature control to maintain the water at a specified temperature, which is usually 25 degrees centigrade for the paraffin determination test. The bath is heated by means of an electric resistance coil located in the bottom of the miniature water pool. The coil is controlled through a telegraphic relay by means of toluol-mercury temperature regulator provided with electric contacts.

The complete equipment for making the paraffin determination consists of: One-half pint iron retort, a piece of iron tubing 30 inches long, two 100-cubic centimeter Erlenmeyer flasks, 500-cubic centimeter flask with side-neck for filtering under pressure, freezing apparatus, 6-inch test tube of three-fourth-inch diameter, analytical balance of 100 grams capacity and sensitive to 0.1 milligram, a rough balance of one kilogram capacity and sensitive to 0.1 gram, wash bottle, seamless pint tin cup, vacuum pump and connections, glass crystallizing dish of 50 millimeters in diameter, steam bath, desiccator with calcium chloride, 4-inch steel spatula, Bunsen burner with rubber tubing, and two iron stands with retort clamp and one ring.



Apparatus that shows the paraffin in bituminous road materials

Photographing Snowflakes

NEXT time it snows, as the first few flakes are gently wafted toward the earth, pause a moment before you crush them ruthlessly under foot, for in these minute particles of frozen moisture nature has created decorative designs that for delicacy of effect and fairy-like beauty equal anything that man has been able to devise.

During the many years that he has devoted to this particular work, Mr. W. A. Bentley of Jericho, Vt., has made 3,800 photomicrographs of snowflakes and has found no two of them alike. As a result of his exhaustive study he firmly believes that the snowflake is the most exquisite example of nature's art.

His work has been difficult and has entailed all of the patience and forbearance of the true scientist. However, he has been rewarded for his years of labor.

The great appreciation that they have received has been a reward in itself to this farmer scientist. As well it has amazed him. When he began this seemingly unimportant study he started to make a series of drawings of the flake designs. These drawings, of which about four hundred were made, proved unsatisfactory. Dry plate photography seemed to afford a medium that would make the photographing of them possible. Mr. Bentley secured an apparatus consisting of an extension camera coupled to a microscope and capable of giving from eight to sixty diameters magnification (from 64 to 3,600 times). Failures came in rapid succession, but with new methods clear, sharp images were at last obtained.

However he soon saw that it was impossible by any purely photographic method to show the crystals naturally white on a black ground. So he tried the tedious "blocking out" method of cutting the negative film away from around the snowflake image. It proved to be a task of monumental proportions, and yet one that must be successful as it was the only means of bringing to light their real beauty.

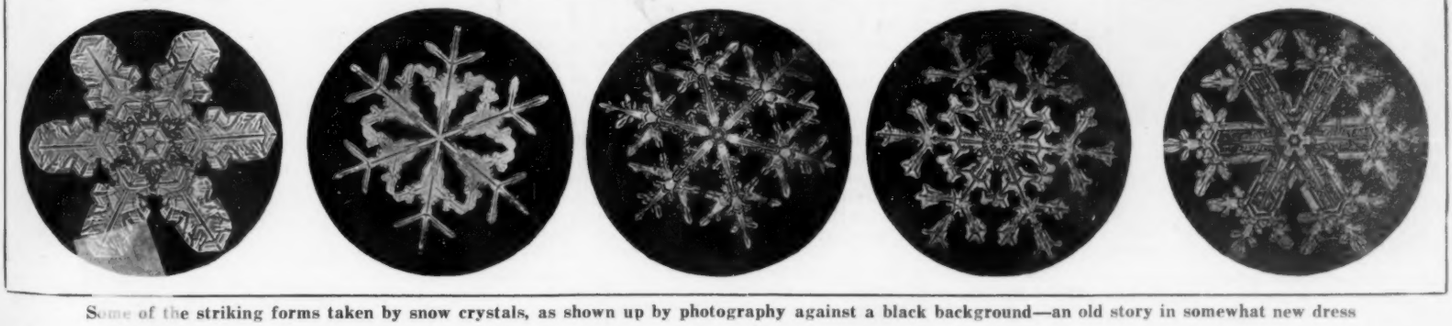
Mr. Bentley feels that it is impossible to convey an idea of the extreme fascination of the work.

The task of photographing the snowflakes is one that is more delicate than difficult. The utmost haste must be used as once the crystals are separated from the mass they evaporate very rapidly, and never last more than a few minutes, even when it is extremely cold.

The crystals are usually caught on a black board as they fall and are then removed to a glass slide under an observation microscope. Only a brief glimpse of them is possible, during which it is necessary to hold one's breath. If suitable they are placed down on the glass slide with the aid of a feather after which the slide is placed on the stage of the microscope, centered, focused, and an exposure of from ten seconds to several minutes given, according to magnification and cloudiness. Ordinary daylight is used for illumination, the apparatus being pointed out of a window for this purpose.

Snow crystals are remarkable in many ways for quantity, distribution, origin, and all the important parts they play in nature's plan. Although built usually according to the rule of six, every crystal grows in kaleidoscopic fashion from start to finish, and almost every moment in cloudland sees them changing form. They are perhaps the most varied and exquisite examples of nature's art.

These ever varying outgrowths while uniting to the parent crystal ofttimes do so imperfctly or in such a manner as to bridge over and imprison minute quantities of air, forming tiny air tubes within them, or diffuse shadings, which outline more or less perfectly the transitory shapes. These present the appearance of lines, dots, and fairy-like geometrical figures in endless variety, and give exquisite beauty, richness and complexity to their interiors.



Some of the striking forms taken by snow crystals, as shown up by photography against a black background—an old story in somewhat new dress

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Copyright, Kadel & Herbert

The non-sinkable mail bag and the non-sinkable suit

Mail Bags That Won't Sink

IN a recent test and demonstration, special bags were taken up in airplanes and dropped from a height of 300 feet into the water and then picked up by a small boat. The bags were found entirely satisfactory, and it is claimed that they will float on the water for an indefinite period when thrown from airplanes, sinking ships and so on. The bags may be picked up by a small boat sent out from shore or from a steamer, or again, by a man equipped with a non-sinkable suit such as is shown in the accompanying illustration.

Making Window Cleaning Safe

HOUSEWIVES who delight in having their home spick and span will delight in the new window construction which is shown in the accompanying illustration, and which is claimed to make window cleaning a safe task. This window construction is the invention of Mr. Sixt and Mr. Bingham of Brooklyn, N. Y. The center bead and molding which together hold the windows in place are cut at an angle of 45 degrees, allowing a section three inches longer than the window to be removed. These strips are then held in place by specially constructed spring snaps. The removal of these strips allows the windows to be drawn inward and the window is then held in position by a construction somewhat similar to a hinge which fits into the wood. When not in use this can easily be fitted into the wall, out of sight.

Special construction for windows which permits window to be swung in for cleaning

A Telephone Which Fits in the Ear

THAT much abused term, "the smallest in the world," is again being used, this time in connection with the tiny telephone receiver shown in the accompanying photograph. A German concern has developed this small telephone as part of a set for deaf persons, and the idea is to have the small telephones fit inside the ears of the users so as to be as inconspicuous and out-of-the-way as possible. The telephone is a perfect bipolar receiver, and has a diameter considerably smaller than the 5-pfennig coin shown beside it.

Whether it is the smallest telephone receiver or not, is a question. It seems that the thermal telephone, which was described in these columns several years ago, is still smaller and also fits in the ear of the user. However, the thermal receiver works on the principle of air expansion due to the heating of a small platinum wire. The purity of sound obtained with the thermal telephone receiver is remarkable, and far superior to the general run of telephone apparatus, due to the absence of a diaphragm. In this connection it is very doubtful if

Tiny telephone receiver which is worn in the ear, and measures less than diameter of a dime

the present telephone receiver with its tiny diaphragm can reproduce speech as clearly as the usual telephone receiver of far greater size.

A Grease Gun for Every Bearing

A NEW grease cup has been perfected by a Mr. Davis of San Francisco, Cal., which is practically a little grease gun for every bearing and does away with all the troubles that other grease cups have, such as leaking through the threads or the plunger, losing the top, crossing the threads, and refilling. It is easily and quickly filled because there are no threads to re-enter, thus saving both time and grease.

One of the leading features of this cup is the spring metal plunger. This is a thin spring metal plunger, slightly concave, like a shallow saucer. It exerts a firm, uniform pressure against the sides of the barrel, making the cup dust-proof, leak-proof, grease-tight and oil-tight.

Not merely grease but oil may be applied with any required pressure just as with the use of a grease gun. It insures reaching all dry or dirt-encrusted parts, procuring positive and thorough lubrication. All grease or oil goes into the bearing and not a particle goes on the outside of the cup, according to the inventor.

The new cup is easily and quickly filled. The metal cup is opened and put back as shown. Compare this with the old screw telescope cups, the ever-recurring bother of re-entering the thread with the danger of crossing threads, thus making the cup leaky and worthless.

Another feature is the unit mechanism. The plunger and top are fastened to the barrel; one cannot lose or mislay a part. After filling the cups there is a surplus that can be used instantly with just a turn of the plunger.

Turning Pliers Into Self-Opening Shears

WITH the attachment for pliers shown in the adjacent photograph, a slip-joint design can be turned into a pair of self-opening shears. It is only necessary to snap on this new shear attachment. The work takes but a few seconds and the convenience of having a tool of such a combination in garage or workshop is self-evident. The attachment will cut wire and metals not exceeding in thickness a medium gage.

A simple attachment which converts ordinary pliers into self-opening shears

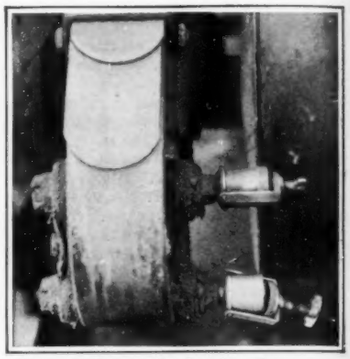
A Ball-Bearing Ventilator

AN American manufacturer has recently brought out a rotary ball-bearing ventilator which is said to maintain a steady flow of fresh air without operating expense. It applies the free power of the passing breeze to create a suction. This ventilator is provided with a fin which causes it to face in the proper direction, no matter how slight may be the breeze, as well as with a set of shutters which may be closed in order to reduce the suction.

Playing Safe with High Voltage Circuits

WOOD, from which the safety platform shown in the accompanying photograph was made, is specially treated so that contact with 25,000-volt circuit will not hurt this workman as long as he is standing on this platform. There will be a discharge to his hand as he makes or breaks contact, due to the capacity of his body, but the platform itself has no capacity so that after contact is made there is no sensation felt.

Similar platforms, provided with railings and suspension members, are now being employed in "live" line work. Such platforms, while ensuring safety, do not handicap the linemen in their work. The linemen can now make repairs without the inconvenience of shutting off the power.



Two of the newly-developed grease cups, shown in use and opened

Recent Patent Decisions

Good Faith Is Not Sufficient in a Trade-Mark.—This is an appeal from a decision of the Patent Office overruling the opposition of the Proctor & Gamble Co. to the application of Eney Shortening Co. for the registration of the sign "Esco" as a trade-mark for a lard substitute.

The opposer shows that it is the owner of the sign "Crisco" as a trade-mark for a lard substitute, and alleges that, as its goods are of the same descriptive qualities as that of the applicant, the marks being similar, confusion would be likely to result in the minds of the public.

The applicant says that its mark is made up of the initials of the corporation with the termination "Co.," and seems to think that there is something in that which should entitle it to have the mark registered. The court denies the force of this argument, and decides to reverse the opinion of the lower court and to hold that the use of the sign "Esco" would cause confusion with the sign "Crisco." It is held that the trade-mark statute takes no account of the origin of a mark, the only question being, would its use be likely to result in confusion? In which case it is unregistrable.—*Proctor & Gamble Co. v. Eney Shortening Co. U. S. C. C. A. of D. C.*

Standing on this little platform of specially treated wood protects the electrician from shock

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

BLOWER DEVICE.—P. COMINA, Aptos, Cal. This invention has particular reference to a pneumatic blower device for recovering and cleaning fruit which has dropped on the ground around the base of fruit trees. The prime object is to provide means of separating dust, twigs, leaves, etc., from the fruit, and to so arrange the device that it may be used in connection with a conventional blower apparatus.

Of General Interest

ADJUSTABLE LEG FOR SINKS AND OTHER ARTICLES.—O. M. REDLON, 181 Front St., Bath, Me. The object of the invention is to provide a supporting leg having means permitting the same to be vertically and laterally adjusted. The structure includes a head with spaced sides and top, the top having longitudinal slots therein, caps U-shaped in cross-section adapted to receive the article to be supported, and bolts passing through the slots adapted to secure said caps in adjusted positions.

BACKBAND HOOK.—G. C. WILLIAMS, Lombardy, Miss. The invention relates to harness, and particularly to a backband hook having locking means to engage the trace. Among the objects is to provide means by which the hook may be readily applied to backbands of known form, locking means to prevent the accidental release of the trace, the hook and its appurtenances being prevented from exerting any rubbing action against the sides of the animal.

METHOD OF AND APPARATUS FOR THE PRESERVATION OF BODIES AFTER BURIAL.—V. BRANCIFORTI, 311 E. 109th St., New York, N. Y. An object of the invention is to produce strong and substantial burial coffin or casket in which the body may be indefinitely preserved. It is a further purpose to provide such a coffin or casket having means for containing certain chemical preservatives which act on the body to preserve the same.

FUR BUTTON.—B. COHEN, decd., address Amelia B. Cohen, c/o Baker & Obermeier, 34 Nassau St., New York, N. Y. This invention has for its object to provide an imitation seal fur button, arranged to provide the desired uniform fullness the same as is found in real seal buttons, and to insure long wear without danger of the button being rubbed threadbare by use.

FASTENING DEVICE FOR CONTAINER COVERS.—C. W. DOBELIN, 619 W. Mifflin St., Madison, Wis. The object of this invention is to provide a fastening device in the form of staples for container covers which can be detachably applied to secure a cover in position to close a container without the necessity of nailing the cover to the container, whereby a cover can be used repeatedly thereby effecting a great economy.

DAVIT.—A. J. DAWSON, 21 Edwyn Ave., Portsmouth, N. H. The invention has particular reference to balanced davits, an object being to provide a mounting therefor, and operating means which results in balancing the weight of a boat so as to reduce to a minimum the power necessary to swing the boat. A further object is to provide a construction which may be used for other purposes than supporting the boats, such as transporting loads from one position to another.

APPARATUS FOR THE MANUFACTURE OF OXYGEN COMPOUNDS OF SULFUR.—T. A. CLAYTON, 48 Rue de la Victoire, Paris, France. This invention more particularly relates to an apparatus in which the air required for the combustion, volatilization, and oxidation of the sulfur, is forced into the sulfur combustion furnace at two different levels, so that the secondary air current may not interfere with the outflow of the gases carried over the primary air current, thus avoiding the back flow of the said gases toward the hearth.

Hardware and Tools

CAN OPENER.—B. G. WORTHINGTON, 19 N. Fir St., Medford, Oregon. The invention relates more particularly to an opener having a pair of knives and movable in either direction around the top of a can for the purpose of opening the same, the object being to provide a simple implement adapted for either right- or left-handed persons, as well as for the use of one knife after the other has become dulled.

PIPE LIFTER.—W. H. SCHULTZ, Bartlett, Ill. An object of this invention is to provide a device by means of which a pipe used in connection with gas wells, artesian wells, etc., may be quickly raised and with no danger of the pipe slipping during the raising operation. A further object is to provide a tool which is simple and therefore not easily liable to get out of order.

LOCK.—H. D. WETHLING, 45 Mountain View, Orange, N. J. This invention has as an object to prevent the reading of the dial of a permutation lock when the same is being opened, thus preventing an unauthorized person from tampering with such lock by trying to open the same for his own personal benefit subsequently.

KITCHEN TOOL.—E. VERSTRAETE, 615 Washington Ave., Belleville, N. J. Among the objects of the invention is to produce a tool for use in kitchens, and in cooking over a camp fire or the like, and more particularly the invention relates to a tool having a tosser element for tossing pancakes or lifting other food for which a broad blade is required, and for lifting pot or pan covers or for lifting small cooking utensils.

NUT LOCK.—T. M. HILSABECK, Lusk, Wyoming. The prime object of this invention is to provide a nut lock formed of the material constituting the body of the nut and unitary and integral with the nut structure. Another object is to provide a nut lock in which the locking elements are accessible to be easily and quickly released and are remote and protected from the strains and stresses incident to the operation and use of the nut.

FISHING TOOL.—H. CURRIER, address Harry Wymore, Rose Hill, Iowa. This invention has particular reference to tools for fishing, dull bits and other implements from wells. An object is to provide a device which upon being lowered into a well or other boring is adapted to engage and hold the object to be removed. A further object is to so arrange the grappling tongs that a variety of different objects may be readily removed from a boring.

Machines and Mechanical Devices

TYPEWRITER ATTACHMENT. — W. D. REID, 334 Macon St., Brooklyn, N. Y. The invention relates to the cleaning of the face of type by an operation which is rapid, and will not soil the fingers of the typist. The device comprises an eraser presenting a pair of side faces, and bristles associated with one of the faces forming a brush, against which the type which has become clogged may be struck for cleaning the same; the brush may be associated with the type guide and is not likely to become lost.

COMPOSITION OF MATTER FOR SEALING PISTON RINGS.—J. W. CALTA, Platte, S. D. An object of the invention is to provide a composition of matter for sealing piston rings so as to prevent oil, gas, etc., from passing the ring. A further object is to provide a composition which will stand high temperature, and which is in itself a lubricant. The composition consists of a refractory lubricating paste comprising soapstone, mica, asbestos fiber, flake graphite, fine plumbago and mineral oil.

SKIN STRETCHER.—S. and B. FRIEDMAN, c/o Reliable Machine Works, 48 Lafayette Ave., Evergreen, N. Y. An object of the invention is to provide a stretching means located at an angle or incline so that when the stretching operation is ended, the skin will fall by gravity from the stretcher. A further object is to provide means for forcing the stretcher bars apart, allowing the bars to adjust themselves to the parallel or angular shape of the skin, and to provide means for reversing the skin when it is drawn from the stretcher.

COMPRESSOR.—G. F. KRIEGER, c/o Krieger Tool and Mfg. Co., Grand Rapids, Wis. This invention relates to compressors such as are used in refrigerating machinery, for the transformation of a refrigerating medium from gas into a liquid. Among the objects is to provide a reciprocating piston structure having an active piston head at each end while the body of the piston intermediate of the heads is provided with a longitudinal bore through which gas may be admitted and passed laterally outward through a plurality of ports, and thence through the piston head past a valve fitted movably in the piston head.

Medical Devices

THERMOMETER COVER.—D. H. MILLS, 2 Ford Ave., Oneonta, N. Y. This invention has for its object to provide a cover of flexible elastic material that may be used during the use of the thermometer to avoid the necessity of washing, drying or the like after use, and to prevent the swallowing of broken glass or mercury in case of breakage, and to provide a sterile or aseptic way of taking temperatures and prevent the transmission of infections and contagious diseases.

CUPPING DEVICE.—T. H. SPRINGER, 323 Broadway, Waterloo, Iowa. An object of the invention is to provide a device by means of which body parts, such as the breast, may be stimulated to produce a flow of blood to weakened or diseased parts by simultaneous electric and vacuum treatments, the device being constructed to hold warm water through which a current is passed while the body to be treated is in contact with the liquid; the cupping device may be easily operated by the patient.

Musical Devices

EXTRACTOR FOR PIANO HAMMERS.—B. J. STARKS, c/o A. H. Shoemaker, Eau Claire, Natl. Bank Bldg., Eau Claire, Wis. The invention relates to a device arranged to readily operate upon the head, the butt, or the back stop of the hammer. A more specific object is to provide a device which may be quickly applied to the hammer in a manner tightly clamping the shank from which the hammer head or other member is to be removed.

Prime Movers and Their Accessories

APPARATUS FOR FACILITATING THE SUPPLY OF OIL TO ENGINES OF MOTOR CARS OR OTHER ENGINES.—W. J. DALBY, 10 Orient Rd., Magill, South Australia, Australia. This invention has been designed to simplify the procedure of supplying lubricating oil in predetermined quantities to the engine of a motor car. The device comprises an upper receiver for holding the oil in bulk, a lower receiver for containing the predetermined quantity of oil to be fed, a valve connected between the two receivers and a valve connecting the lower receiver with the engine. The taps to the upper and lower receivers may be operated independently or by a rod so that when one is opened the other is closed.

Railways and Their Accessories

DRAFT GEAR.—G. M. SCHWEND, 1923 W. 13th Ave., Birmingham, Ala. The invention has for its object to provide a gear of the character specified especially adapted for use with locomotives of any character, and so arranged as to prevent jerking of the cars in starting and in stopping. The device is operated by means of the draw bar which is connected with compressed air cylinders by which the movements of the locomotive will be cushioned.

CONTINUOUS RAIL CROSSING.—C. M. RIHN, decd., address Jas. M. Rihn, 1803 W. Main St., Louisville, Ky. The purpose of this invention is to provide a track crossing which eliminates the usual gaps in the surfaces of the track rails at the points of intersection, whereby the usual objectional and detrimental jars to which a car is subjected in traversing a crossing are eliminated.

DANGER SIGNAL.—P. M. FELTHAM, Edgefield, S. C. The invention relates more particularly to danger signals for road vehicles, adapted to warn the driver of an automobile or other vehicle of the proximity of a railroad crossing, dangerous curve or other danger. An important object is to provide a device which will not impair the smooth surface of the road, the yielding obstruction ocered to the passage of the vehicle being such as not to occasion discomfort to the occupants, or become interfered with in any manner by sand, snow or ice.

Pertaining to Recreation

TOY.—E. J. CEDARBERG, 346 Bloomfield Ave., Caldwell, N. J. An object of the invention is to provide a toy which represents a kangaroo and which is adapted to be ridden by a child and in its movements assimilate the movements of a kangaroo. A further object is to provide a toy which can be sold at a reasonably low price, which will be attractive in appearance as well as beneficial physically to a child using the same.

TENNIS RACKET.—P. A. VAILE, 565 W. Washington Blvd., Chicago, Ill. Among the principal objects which the invention has in view are to enable the game of tennis to be played within restricted bounds, to train players of the usual game of tennis in the art of volleying, and to avoid rebounding of the ball. The desired result is accomplished by a racket comprising an open frame of the usual type with a loosely formed net producing a tendency to deaden the ball.

GAME DEVICE.—C. V. TORREY, 137 Front St., Marblehead, Mass. This invention has particular reference to a game device employing a surface projectile which is adapted to be projected over a playing surface to knocking down vertically presented pins, as in the game of ten pins and the like. This object is accomplished by the provision of a mechanical manikin constructed to enable the arm thereof to impel the projectile as thrown by a bowler down a bowling alley.

Pertaining to Vehicles

AUTOMOBILE LOCK.—R. R. STABLER, 702 Fidelity Bldg., Baltimore, Md. The invention relates to locks for steering wheel shafts. The foremost object is to provide a lock that is operatively combined with the ignition circuit in such a way that the ignition circuit is broken as the lock is moved into the locked position, and is so arranged that the ignition circuit cannot be broken until the lock goes into place.

TIRE.—W. D. HOOK, 309 W. Waldbrig St., Savannah, Ga. This invention has for its object to provide a tire especially adapted for motor vehicles and capable of being attached to the usual wheel for providing a nearly as possible the resiliency of a pneumatic tire without the liability of the said tire to injury from punctures, blow outs and the like.

DEMOUNTABLE RIM.—L. H. KRICKEL, address Chas. Schulze, Monroe, La. An important object of the invention is to provide a demountable rim of great strength and durability, which is positively supported and secured with its parts locked in assembled position upon the wheel, but which may be readily removed from the wheel and readily and easily demounted.

LUBRICATOR.—E. J. TIMERMAN, 232 Crescent Ave., Syracuse, N. Y. The present invention relates generally to lubricators, and pertains more particularly to lubricators for vehicle spring shackles. It is the prime object of the invention to provide means by which the lubricant may be effectively applied to the bearing surface of the spring shackle.

CASING HOOK.—P. S. BROOKS, JR., Sewanee, Tenn. The invention has for its object to provide mechanism of the character specified, by means of which an old casing or a number of pieces of casing may be firmly secured on the outside of a worn tire to permit the worn tire and the worn casing sections to be utilized. The device comprises a yoke-shaped body adapted to fit about the felly and double hooked arms extending radially of the felly to hold the casing.

SPRING SUSPENSION PIVOTAL ATTACHMENT FOR THE WHEELS OF MOTORCYCLE SIDE CARS.—H. CHRISTIANSEN, 77 Raadhusplads, Copenhagen, Denmark. The invention relates to a wheel or wheels for use with a side car connected with a motorcycle. An important object is to provide a wheel mounting whereby suitable springs may be connected and whereby the wheel or wheels of the side car are free to turn in steering operation.

Railroad Accidents and How They Work

(*Continued from page 241*)

is taken by the 887 crossing accidents, which managed to do away with the lives of 375 people. It is clear enough that about the surest way of getting killed by a train is to stand on the track and let it hit you—that this is much surer, even, than to be aboard a train that gets violently spilled off the right of way by impact with another train. The collision, however, maintains third place, with a death roll of 67. Next to it stands the derailment, accountable for 42 deaths in the period discussed; and 35 people were killed because they couldn't wait for the next train or because they had no time to allow the train on which they were riding to come to a full stop before alighting. The engine defects could not have been in general so serious as the one we have pictured, since they cost the lives of only 8 men; and a like toll was taken by miscellaneous accidents.

On the percentage basis again, the service accident accounted for 45 per cent of all the people killed—practically the same showing as that made in frequency; the crossing accident for 39 per cent; collisions for 7 per cent; derailments and boarding-and-leaving accidents for 4 per cent each, more or less; and engine defects and miscellaneous accidents somewhat under 1 per cent each.

Comparison of the two percentage showings makes it quite clear, as of course we should have known, that the seriousness of accidents is not constant. We can perhaps get a line on this by figuring up the average number of persons killed for accidents of each sort—something which our drawings do not directly do. We find that in order to represent the results as whole numbers we shall have to put them in the form of so many accidents of given character per death caused. On this basis, we see that it takes 2.4 crossing smashes, 20 service accidents, 32.5 collisions, 63 miscalculations with regard to the speed of moving trains, 22 engine mishaps, 71 mischances of the unclassified variety, or 118 derailments, to kill one man.

Saving Coal by Reducing Power Waste

(*Continued from page 245*)

quent loss of efficiency. The board, however, furnishes an ever-present check. These are only a few instances showing the value of the device.

And the beauty of the scheme is that the man in charge of the board will not even have to watch the readings on the instruments to keep track of things, for it is planned to have an alarm bell and an incandescent lamp with a red bulb under each instrument, as warning signals, which will operate when the temperature, pressure, etc., as the case may be, get beyond prescribed limits.

The instruments, which have nickeled cases, are mounted on a beautifully polished marble slab, six feet high by thirteen feet long. They record the following:

Temperature of kitchen hot water; city water pressure; level of water in tanks on roof; temperature of house hot water; temperature of drinking water; high pressure air system (used for turbining boiler tubes, etc.); voltmeter (showing speed of exhaust fans on roof); temperature of laundry hot water; pressure of house hot water; pressure of hydraulic elevator; boiler "blow down"; high and low pressure steam returns; ground-floor ventilation-air temperature; boiler feed-water temperature; pressure in annex steam-heating system; outside temperature; steam pressure of boilers; pressure of house heating system; sewer water from ice machines; city water temperature; temperature of low pressure return brine (for ice machines). In addition each of the three ice machines has

four instruments: steam pressure in generator coils; temperature of outgoing water; temperature of outgoing brine; pressure of ammonia in the generator.

There is room on the board for about a dozen more instruments. Among other additions contemplated are an instrument for measuring the velocity of the wind, which will be valuable in preventing damage to flags, etc.

Keeping Check on Gas Burner Performance

(*Continued from page 245*)

in pressure caused by this meter air is permitted to flow through the 40-cubic-foot gas holder. The joint use of these various devices constituting the laboratory-test unit is so effective that the air and gas enter the burner at such uniform pressure that fluctuations thereof in the burner are less than one-thousandth of an inch of water pressure.

The top of the box, shown at the right in the foreground of the illustration, is left open and the burners operate in a normal fashion. The pressure in the burner is indicated by a very sensitive slope U-gage, xylene being used in this pressure-recording instrument. Minimizing the hazards that otherwise might be caused by explosions in the box attributable to the harnessing of a combustible mixture, a piece of oil paper is pasted on one side of this box. This answers the demands for an adequate explosive head.

Ultimately, this Government bureau should be enabled to indicate to industrial as well as domestic appliance manufacturers scientific methods of procedure in designing gas-appliance apparatus. To minimize gas consumption by one-half may appear as a fantastic dream, but a scientist of the Bureau of Standards thinks that such an ambition is not a remote accomplishment.

Phosphates by a New Process

(*Continued from page 245*)

costly losses are entailed in divorcing the impurities from the phosphate material, finely divided particles going to waste. It is computed that the wastage is twice as great as the volume marketed, with mechanical and chemical skill yet failing in its efforts to draw a dividing line between the phosphate and these impurities.

Although the commercial practicability of producing phosphoric acid from mine-run phosphates by this new process has not been established, the Government authorities are inclined to be prophetic as to the maturity of plans. Material in the hard-rock regions of Florida as it occurs in the mines has a composition which is said to be admirably adapted to this furnace treatment. Furthermore, instead of necessitating enrichment by supplementing of higher grade phosphate much of it must be brought to the desired composition by the addition of silica or sand, of which there is an abundance throughout the phosphate-mining area.

If the new process can eliminate the costly operation of washing and screening plants, coupled with the possibility of prolonging the life of the phosphate deposits, the additional expense involved in the preparation of briquets and the use of fuel oil instead of sulfuric acid as a reagent will be more than offset by other advantages. According to claims, the concentration of the product gives an advantage of standing the expense of longer shipments than the ordinary phosphoric acid, which contains only from 16 to 18 per cent of the soluble phosphoric acid. Combine this concentrated phosphoric acid with ammonia and potash and the highest grade of fertilizers is the result, so say the Government experts.

Canada's Superpower Zone

(*Continued from page 246*)

every community, large or small, conditional only upon its being prepared to make a contract with the Commission and to assume the liability that accures on account of such an undertaking. There is no discrimination. The small user buys electricity at the same price charged the large consumer; and there is a standard rate in each locality agreeable to the circumstances that control there. The dominating purpose of the Commission is that there shall be an equality of right to power in all areas within range of the current generated in any of its plants. The longest transmission distance now spanned by the Ontario Hydroelectric system is 250 miles from Niagara to Windsor, just across the boundary river from Detroit. The people of Windsor pay 40 per cent less for their energizing current than the citizens of the far larger Michigan municipality.

The territory over which power is now transmitted by the Commission extends from the Ottawa Valley on the east to the Detroit River on the west, and from the shores of Lake Erie and Lake Ontario on the south to the regions north of Lake Superior. The latter district, however, is disasssociated from the principal field of service. The desire of the Commission has been to extend the convenience and the stimulating productive effect of electricity wherever possible, and to this end the farm dwellers are being brought more and more within reach of hydroelectric power sources.

As is well known, when the general load increases the cost of delivery of current diminishes; and on this account the heavier charges for wages and materials since the war have been more than counterbalanced. In some cases the credit sheets of the communities show sinking funds nearly equal to the original expenditures for the local plants, and by reason of this it will be possible to extinguish in fifteen years or less debts that were only expected to be wiped out in thirty years. Again, where circumstances call for it, the surplusses are being reinvested in bettering or enlarging existing equipment. The City of London, in 1917, after paying all charges and keeping its powerhouse, etc., in first-class condition, had a surplus of $76,000 on an initial investment of $750,000. Because of extensions and improvements this bustling Ontario municipality has a plant today valued at $1,200,000. Over a third of this installation is now free of sinking fund and interest charges and is subject only to maintenance and operating expenses.

In the earlier days of hydroelectric development in Ontario, the Commission bought all its supplies from dealers and manufacturers, but as its operations expanded the organization found it expedient and more economical to obtain its lamps and other equipment in large quantities and then to provide the municipalities from this stock, thus enabling the consumers to get these things more cheaply.

Perhaps a financial summary will give a more complete idea of what has been achieved in Ontario through this pooling of the public interests for the promotion of a wider employment of hydroelectric energy. The installations owned by the Commission, and by which it serves a multiplicity of communities with power and light, represent a cash value of $56,923,000. This includes the ertswhile privately held Ontario Power Company's works. The equipment belonging to the various constituent municipalities under the direction of the Commission is worth $24,298,870, making a total of $81,221,870. The administration offices and the buildings for other purposes could not be replaced for less than $1,500,000. The total cost of the Niagara power development is $15,000,000. If, to these fixed assets, be added the value of materials and supplies on hand, securities, interest-bearing investments, sinking fund deposits, etc., the combined monetary strength of the Commission can be put at $106,000,000.

Relativity and a Rotating Disk

(*Continued from page 247*)

to be either negligible or somehow compensated in the above ideal exposition. Existence of such strains, however, would leave the fundamentals of the problem unchanged.

Now suppose that before the disk had been set in rotation, *A* made scratches on the surface of the disk at the ends of each of the measuring rods which he has set out. If he uses the distance between each pair of adjacent scratches as his unit of length, the ratio of circumference to radius must of necessity be 2π, no matter whether the disk is at rest or in rotation. This method of measurement gives him a Euclidean geometry under all conditions. Now suppose the first hypothesis of the last paragraph to be true. Then when the disk is in rotation, the distance between two scratches along the periphery, as observed by *B*, will agree with *B*'s unit of length. The contraction of the special theory will be absent. However, the measuring rods set out by *A* along the circumference of the disk will not quite reach from scratch to scratch. Obviously, the disk may be made of the same material as the measuring rods. The latter, not being under constraint, have contracted as compared to the distance between scratches on the edge of the disk. Hence the disk must be under tension around the circumference. If a slit is cut along a radius of the disk from center to edge, then when the disk is set into rotation this slit will grow into a gap which will become wider the greater the speed. However, the gap will be exceedingly small under any conditions realizable experimentally. For instance, at the edge of a disk ten feet in radius rotating at the prodigious speed of a thousand revolutions a second, it would have a width of about a millionth of an inch. These conclusions, of course, are based on the assumption that the radius of the disk, as measured by *B*, is unaffected by the rotation. The phenomena taking place if the radius should change can easily be worked out by the reader. Examination of the problem brings out the important fact that the character of measured space is dependent on the method of measurement employed. One convention regarding units of length leads to the conclusion that a certain region of space is non-Euclidean, while another gives the same region a Euclidean character.

Watermarking Hand-Made Paper

(*Continued from page 248*)

by the King of Italy, The Pope and were used by the late Theodore Roosevelt and Elbert Hubbard. Ex-Kaiser Wilhelm also used correspondence paper with his watermarked portrait before his downfall.

The first colored watermarks were made in England about thirty-five years ago but have been carried to a greater degree of perfection by the continental paper-makers. Each sheet is made in two thin layers and between them is placed a third layer in the form of a design in any color. The lettering or design is produced by using a stencil placed over the mold and cut in the form of the lettering. As many colors as desired can be inserted between the two layers of wet pulp but each color must be formed separately. The lettering so formed is only visible when the sheet is held to the light. Non-running dyes are used so the design will not spread its color over the two outside sheets which are white in most instances. Owing to the skill and time required in making colored watermarks they are used only in the most expensive and elaborate papers.

There is not much similarity between a watermarked paper produced on a hand-mold and one made by the dandy-roll of a paper machine. In the former the wet pulp lays over the design on the mold during the entire making of the sheet of paper, while in a machine-made sheet the mark is pressed into the wet pulp from above after the sheet in the wet state has been completely formed.

For making a watermark in machine-made paper the design is soldered to a large brass skeleton roll the width of the paper-machine and is called a "dandy-roll." This cylinder, supported at each end by an axle, revolves upon the surface of the pulp and imparts to the fibrous pulp the design attached to its surface as well as the laid lines of which the skeleton roll is composed. Therefore all laid papers made on a paper-machine are an imitation of the laid lines of a hand-mold as the natural finish of a machine-made sheet of paper is wove.

It is the pulp laying constantly over the watermark design on the surface of the hand-mold during the entire operation of forming a sheet that gives it the superior qualities and sharpness of line. In this way the pulp is held in different thicknesses to conform to the applied wire watermark while in the dandy-roll watermark of the paper-machine the design or form is simply pressed into the wet sheet from above which pushes the fibers aside and therefore a sharp and distinct watermark, like the mark in a sheet of hand-made paper, is not possible.

Putting Rejected Oranges to Work

(*Continued from page 250*)

From the filter the juice is conveyed in glass-lined pipes to the cooking department where it is mixed with a uniform quantity of sugar, and the individual lots are cooked to a uniform consistency by expert women cooks. A small part of the very best fruit is selected and choice strips of peel are taken off from the center of the fruit and run through a special device known as a shredding machine, which chops the strips of peel into very fine shred. This raw shred is then put in a steam cooker and cooked until it becomes very tender. The water is then pressed off and the dry cooked shred is added to the marmalade before it reaches the finished point, and this shred adds the flavor of the peel as well as gives a delicate body to the finished marmalade.

After the pans of marmalade have reached the finishing point they are immediately removed from the cooking table and the marmalade is emptied into a large enameled tank, which supplies the filling machine. On one side of the filling machine is the glass washing machine, where the empty glass is carried through a bath of hot water and live steam, and delivered to the filling machine sterile and dry for immediate filling.

After leaving the filling machine the glass is passed over an inspection table, where each glass is candled by a woman inspector, and at this point any jars containing thick or scorched shred or other discolorations are removed, and the inspector places on the glasses, that pass inspection, the cap. The glass and cap are taken off the belt by the capping machine operator and the caps are automatically sealed down after a 25-inch vacuum has been exhausted under it.

From the capping machine the glass is conveyed to the labeling machine, where the labels are put on mechanically, and from the labeling machine the packages are conveyed to the packing table, where they are packed and prepared for shipment.

Cull lemons are utilized, principally, in the manufacture of citric acid, although orange and lemon oils are extracted from the peel and used for food and medicinal purposes. In 1919 the Exchange Orange Products Company handled 13,000 tons of lemons not suitable for Eastern shipment. Practically all of this quantity of fruit was converted into citric acid and citrate of lime in the company's own plants.

Unmarketable lemons, arriving by carloads, are unloaded by means of belt conveyor and carried into the plant. The lemons are run through three different power presses in order to extract all pos-

sible juice, from which the acid is made, and the refuse and pulp is removed to storage bins, later to be used as fertilizer on the orange groves of the members.

The juice from the press is pumped into large storage tanks and held until passed to the boilers. The juice is clarified by filtering and is then boiled with a solution of lime and chalk. This process neutralizes the juice and results in the formation of calcium citrate. The calcium citrate is separated from the neutralized juice by means of a filter press, and by adding sulfuric acid the juice forms a weak solution of citric acid, which is then converted into a strong crude citric acid liquid by boiling under vacuum in a vacuum pan. From these vacuum pans the crude citric acid liquid is pumped into the first crystallization pans, where it forms, when cool, a thick black mass. This mass is then redissolved and all impurities taken out, and again boiled under vacuum to the point of crystallization. While still in liquid form it is pumped into shallow pans to cool, and when cool it appears in pure white crystals. The material is then transported, by means of dump cars, to the centrifugal machine, where the crystals are thoroughly washed, dried and all impurities removed. The citric acid crystals are then graded according to size and are packed in barrels ready for shipment.

Another product made from cull lemons is lemon oil of which the world consumes annually more than a million and a half pounds, and about half a million pounds of oil secured from orange peelings. It is hoped to supply a large share of the American demands from the by-products plants operated in southern California. Lemon oil made from frozen lemons was sold to a large confectioner who reported that the results secured with it were fully as good as with the imported product previously used, and he agreed to take all that could be produced at the experimental plant.

Practically all of the citrus oils used in this country are imported from Italy, being produced there by hand. In the California laboratories the problem is not only to produce oils of equal quality with the imported, but to devise means for doing the work by machinery. On account of the high wage scale in this country it would be impossible to compete with Italy under the hand method, and as a first step in doing this work mechanically a new machine has been invented by one of the government chemists to peel the citrus fruit.

The method of extracting orange or lemon oil used in Italy, Sicily and other parts of southern Europe is to peel the fruit by hand, either cutting it in half crosswise and scooping out the pulp or by stripping off the peel in three longitudinal pieces. The peel thus secured is inverted and pressed over a small sponge. By this means the oil cells of the outer part of the peel are ruptured and the mixture of oil and other liquids is forced out in a tiny spray. After the sponge has become saturated, the contents are squeezed into a bowl, and the oil is eventually drained off the accumulated liquid.

Through a thorough utilization of all the fruit grown on the citrus groves of California, the industry will be stabilized and the consumer of perfect fruit will not have to bear the entire cost of the crop, for all classes and grades of fruit will have a distinct value.

Using the Vacuum Tube So That the Deaf May Hear

(*Continued from page 251*)

sensitive microphone or transmitter, as distinguished from a highly sensitive instrument which would pick up all kinds of parasitic sounds; a small vacuum tube, transformer, filament rheostat, filament battery consisting of a standard dry cell, a high-voltage battery comprising 16 cells with a potential of 24 volts, and a pair of telephone receivers. The volume of sound is governed at will by regulating the filament rheostat. Despite the employment of an insensitive microphone, the device is extremely sensitive and amplifies any desired sounds because of the amplifying properties of the vacuum tube. It is claimed that this device enables persons afflicted with deafness to obtain better results than have heretofore been secured over the ordinary telephone.

No doubt Mr. Hanson will be recalled as the inventor of the radio cable which enables ships to pick their course by intercepting electromagnetic waves emanating from a submarine cable. His present device was developed largely through the facilities extended by the Volta Bureau of Washington, D. C. This institution was endowed by Dr. Alexander Graham Bell for conducting research work to prevent deafness and to aid those who are hard of hearing.

Making Barrels Out of Paper

(*Continued from page 251*)

two halves of the mandrel draw away from each other, each carrying its strip of paper along. Thus the proper length of winding is obtained for the height of the barrel being made. After the requisite number of turns have been made to gain thickness, the slitting wheel is thrown out of action and the paper becomes a single strip again, winding several layers on the center of the barrel, to form the bilge. The paper strip is then cut, the mandrel parts separated still more, and the finished barrel removed. The entire operation requires less than one minute.

Silicate of soda, commonly called water glass, is used as the adhesive. It sets quite rapidly so that the barrels are ready for use shortly after leaving the machine. The paper employed is chip board paper, which comes in rolls. A wooden head may be employed to finish the barrel, or, if desired, special pressed steep ends may be used. The finished barrel is light, strong and clean. It is tight. However, as to cost the paper barrel is not so cheap as the ordinary slack or tongue-and-grooved wooden barrel, due to the high cost of chip board paper at present. There is no neater container than the paper barrel, and it is ready to stand the same kind of handling as the usual wooden barrel.

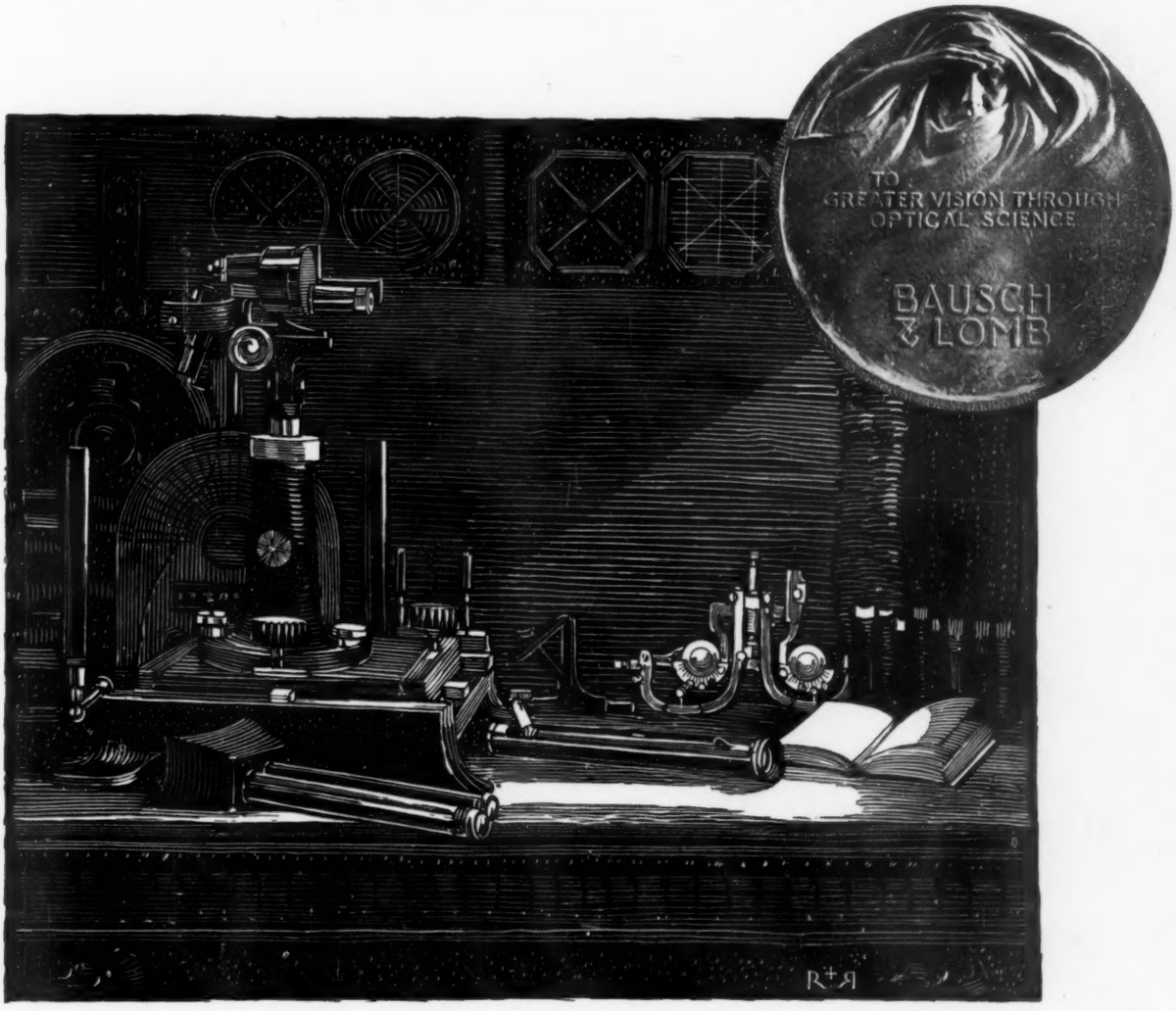
Combined Tire and Caterpillar Tank

(*Continued from page 251*)

speeds equal to that of the motor truck.

It will be remembered that when tanks were used in the great war, everything possible was done to secure one of their greatest assets, that of surprise. But it was not always possible to make surprise attacks because of the delay in concentrating the tanks, which had to be hauled to the concentration point either on railroad cars or motor trucks. The object aimed at in the new tank herewith illustrated is to secure greatly improved mobility, and it is believed that this has been achieved, since they can run on the roads on wheels, and thereby be capable of the quick concentration which is necessary to carry out an attack unexpected by the enemy.

The war has proved that men can be trained more quickly than the ordnance material required to arm them can be produced, and the problem of the Ordnance Department is to stimulate interest in the design and production of war munitions. In accordance with that policy, this particular tank is being built by private manufacture, in coöperation with the Ordnance Department. Excellent work is being done along this line by the Army Ordnance Association, an organization of civilians and army officers who were largely responsible for the production of arms during the war. The Society of Automotive Engineers has a special committee whose purpose is to consult with the Ordnance Department.



Man's Eyesight Measured That Science May Protect It

OF all the senses given by God to man, Sight is the one most greatly treasured. Soundness of vision! What a world of varied form and color and widely-ranged activity it opens—yet on what supremely delicate adjustments of glass to eyes it oftentimes depends. Science has taught us this, yet not too soon for the welfare of human sight. Only a generation or so ago men tried on glasses very much as they try on shoes—till they found the lenses which it seemed to them would "do."

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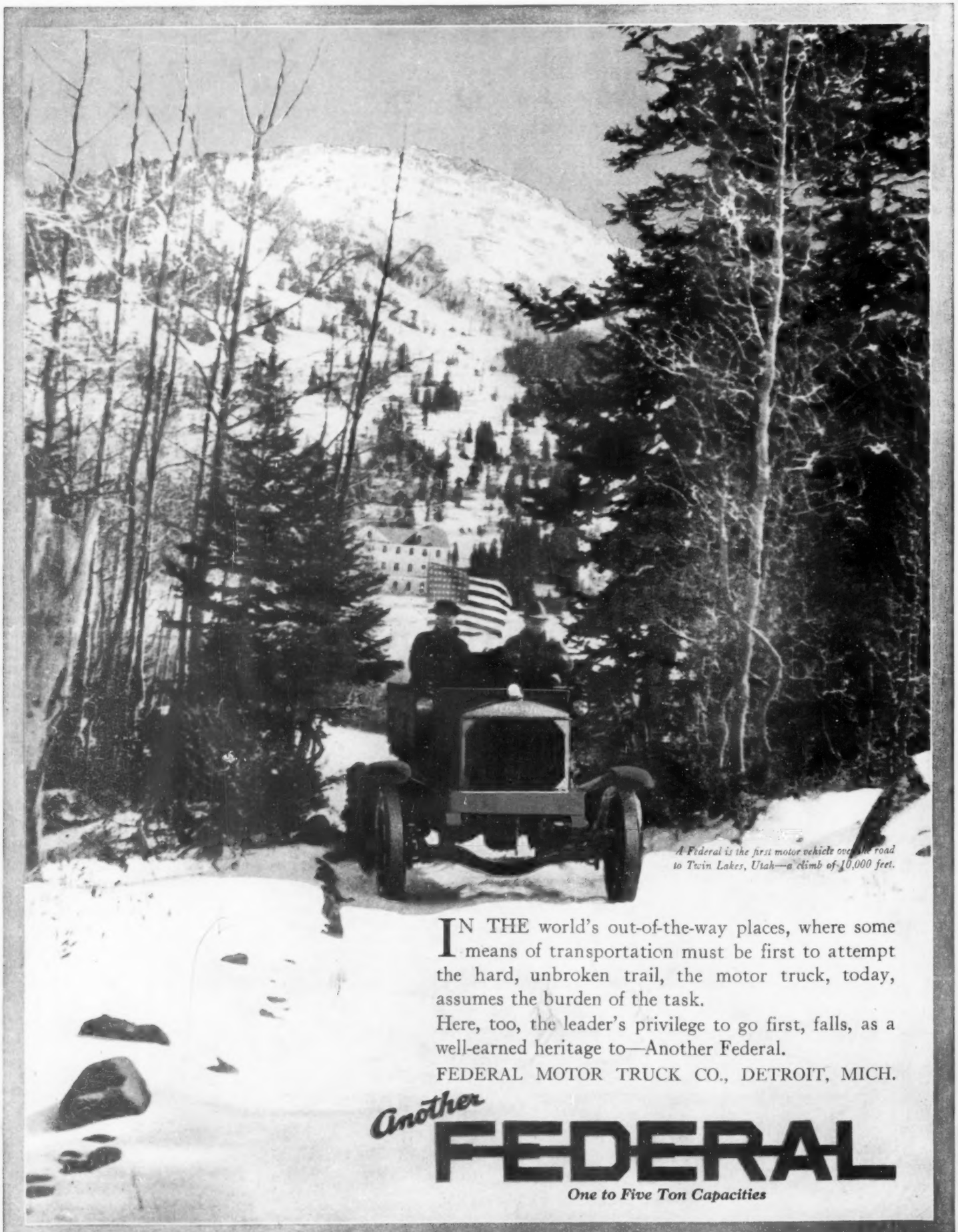

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